THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

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ENGINEERING EDUCATION IN THE UNITED STATES.

THE Governing Body of the Northampton Institute having decided last winter to make an investigation into the methods of giving technical education in the United States, sent their Principal, Mr. R. Mullineux Walmsley, upon a three months' tour last March through that country in order that he might have opportunities of watching the processes employed during the actual sessions. His report, which takes the form of a pamphlet of 15 pages, is now before us, and may be regarded as a one-man anticipation of the second Mosely Commission that has just left our shores. Mr. Walmsley inspected some 34 colleges, institutions and schools in the States and Canada, and interviewed a large number of employers, manufacturers and professional men (whose names are given in appendices), as well as the teachers in the various establishments. Dealing with the students themselves, Mr. Walmsley states that they can be counted in hundreds as compared with tens or less in this country, that they enter these colleges at a later period of life, and that on the average they are better prepared for their work. The American boy usually spends fours years (*aetat.* 6—10) in a primary school, four years (10—14) in the grammar school, and four years (14—18) either in the high school, which has a classical or literary bias, or in the manual training school, or manual training high school, which are scientific and practical. The undergraduate courses in the engineering colleges generally last four years, sometimes five. Of the college staffs, Mr. Walmsley says that the engineering professors are not only permitted, but are actually required, to undertake outside work, in order that they may keep themselves abreast of progress. The dean of the faculty and the president are supposed to be able to see that this plan does not cause neglect in the teaching. Practically, therefore, the colleges have to compete with manufacturers for the services of the best men as teachers, and, in consequence, professional salaries are higher than with us. The professors, once appointed, are allowed very free hands, setting their own examinations; but since there is a keen rivalry in the States among manufacturers to obtain the finished students from the most respected institutions, and since those manufacturers immediately detect any diminution in quality, the success of a college depends upon the value of its products as tested in actual life, and not as tested by (inside or) outside examiners. Generally speaking, employers only view with favour such applicants for employment as possess a graduation certificate from the engineering department of a university or of a technical school, and many will only accept as apprentices holders of such certificates.

The employers all pay a living wage from the start, the premium apprentice being unknown in America. The graduates, nevertheless, are expected to begin work at the

very bottom, and are alive to the necessity, for the teachers have almost succeeded in stamping out the "know-it-all" student. As a rule, says Mr. Walmsley, students enter and thrive in factories according to their merits, gaining, if they deserve them, well-paid posts in two years. Nepotism and allied forces are less powerful than here. The large manufacturing concerns of the States not only absorb or struggle for the best students of the institutions of highest repute, but urge on the institutions the necessity for thorough training, offering pecuniary and other assistance. The Vice-President of the U.S. Steel Corporation issued a circular letter to the colleges and schools on these very lines last year, ending: "We want ability, will recognise it, and pay for it." Manufacturers put large up-to-date machines at the services of the colleges; the State University of Illinois has an experimental railway car presented by the Central Railway Co. for testing brakes, &c., and the railway people haul it about for long journeys to allow the tests to be made. The Pennsylvania Railroad Co. permits students to travel on their locomotives, taking indicator diagrams and making other tests of real value—we rather hope they are goods locos! The pamphlet concludes with several brief reports upon subsidiary questions: training of bench hands, manual training schools, trade schools, horological and optical education. The pure trade schools are condemned, and the evening technical classes are said not to have "caught on" in the States. Apart from these, Mr. Walmsley sums up the results of his inquiry in the following words:—"The parents of would-be engineers, recognising the importance of a thorough training and its influence on the subsequent careers of their sons, are willing to incur the expense of continuing their training up to 22 or 23 years of age. The schools are numerous, well equipped, and fairly well staffed, and their curricula, on the whole, are well adapted to the requirements of the profession; and the employers and manufacturers are convinced of the importance of the training given in the schools, and, for the present, are willing and able to find places for and to give a fair chance to every graduate turned out, and also to render assistance to the schools by the free gift of machinery and apparatus, and in other ways."

The Electric Lighting Season.

This is the time of the year when electric fittings manufacturers and traders are preparing for a rush of business. On every hand catalogues have lately been brought out or are now in course of preparation, showing manifold new designs of fittings and various small devices, which are to be laid before the buyer and the user in readiness for the 1903-1904 electric lighting season. For many months past artistic ingenuity has been exercising itself in the designing of something new, something different from what has hitherto been placed upon the market, and the result is in evidence at the numerous electric fittings show-rooms which have been established in various parts of London and the provinces, so that the contractor, the consulting engineer and the architect may take their clients to make their own selection of electroliers, brackets, standards or so forth, after seeing them "under light." Some of the showrooms that we have had the pleasure of visiting lately in our efforts to discover things new and interesting, are veritable fairy lands, and one becomes almost confused by the very profusion of artistic excellence both in the design and execution of the fittings work, the soft and beautiful effects produced by tasteful shading; one is also impressed by the great pains which have been taken in most cases to obtain neatness, harmony, and unobtrusiveness in the general setting out of the numerous classes of designs. Busy contractors and engineers who want a little quietness might do worse than wend their way to one or other of these secluded resting places, with soft and downy carpettings, and enter into a little of the history and the imagination which have combined to make the modern artistic fitting what it is. Antique designs, hammered iron and copper work, oxidised silver and armour bright fittings are all the rage, and promise to continue so during the season, but they are not overdone, and there is a pleasing variety of statuary, polished brass and other lines. There is everything that can be wished for, from the plain, cheap polished bracket, to the elaborate specimen of fine and detailed work, such as the wealthy owner of an ancient country mansion desires, work which sometimes involves great study and research in order that the design may be brought as nearly as possible into keeping with the ancient character of the furnishings and buildings. It occasionally happens that the designer, having made a visit of inspection to the various departments of the mansion to see what his work has to harmonise with, has to hark back several centuries in his efforts to be precise. Needless to say, under such circumstances the owner makes no quibbling about the expense. There never was a time when the services of the artist and the metal worker were so much in demand, or so genuinely appreciated, as they are now in these particular spheres. The old gas fittings, excellent as they were and are, can hardly be compared with the charming varieties which are made available by the accommodating qualities of electricity for the purposes of illumination. This is one of the many benefits which must become even better recognised from year to year as the use of electric lighting makes headway. No one will ask for evidence that electric lighting is continuing the rapid strides which have characterised it for several years past; it is plainly shown in every item of lighting news from every quarter of the world, and it is especially noticeable in the activity of the works devoted to the manufacture of electric lamps, fittings, and so on, and in the establishments devoted to their exhibition.

Gas Engine Progress.

Our comments of last week respecting the prejudice which has characterised the attitude of too many central station engineers toward the gas engine are supported by one of our correspondents this week. Of course, there are some very noteworthy examples of engineers who, whatever their inbred predilections in the matter of prime movers, are not only theoretically alive to the important development which is going on in gas engine design and construction, but are prepared to practically proceed upon up-to-date lines and avail themselves of a class of equipment from which, according to the opinions of leading authorities—opinions which have been borne out by some actual practice—so much is to be expected. The gas engine industry, if it is going to confer such unmistakeable advantages, should be fostered, not hindered by a too cautious nervousness on the part of those who rest contented with steam engines which they have, or too hurriedly extend a gas engine station on the steam engine principle. That is not the spirit that should receive place in a branch of engineering in which there is so much evidence of movement forward in the direction of something better. Sir Frederick Bramwell's prophecy of several years ago of the supersession of the steam engine, which formed the subject of one of the interesting little items of the Southport meeting of the British Association, is not his prophecy alone, but it is the view of hundreds of engineers in all parts of the world.

It hardly needs saying, however, that the steam engine is not dead yet, and that it will continue to be a faithful servant of the human race for many a long day; 30 or 40 years is a safe period for the prophet to dream about, and even now, while the Bramwell contribution is being invested in Consols, we are in the presence of very real progress in the direction of turbines and large gas engines. The report of Messrs. Willans & Robinson, who, as our readers are aware, are now occupying themselves with the manufacture of gas engines as well as of steam engines, contains one very hopeful paragraph. It appears in our "City Notes" to-day, and shows that Redditch Electricity Dept. has erected a

375 I.H.P. vertical gas engine; St. Helens has ordered a horizontal one of 750 I.H.P.; and two of about 1,000 I.H.P. each are on order for Reading. There are also others; but there are various other English builders of large power gas engines, and they are equally full of the same class of work, while on the Continent splendid progress has been made by makers whose work has been made familiar to the English reader through the admirable papers read by Mr. Humphrey. In America, as it would seem from the discussion on Mr. Emmett's Saratoga paper, very little is known about it, and one authority holds that the gas engine will receive a set back from the turbine. At St. Louis Exposition, however, arrangements are being made for the exhibition, in 1904, of a 3,000-H.P., or even a 6,000-H.P. Continental gas-driven plant.

Car Controllers.

We in England have not experienced to any marked extent the trouble of the "blown up" controller, simply because the arc-breaking capabilities of the controllers used have been sufficient under general circumstances to deal with the moderate currents involved in the operation of two motors ranging from 15 to 30 H.P. Now that the use of 4-motor equipments is becoming more than a matter of timid experiment in hilly districts, while at the same time running speeds and, therefore, power of motors are increasing, we are more likely to hear of a trouble which has been confined almost entirely to America. There the 4-motor high speed interurban, each motor ranging from 40 H.P. to 125 H.P., is almost too common to talk about, and experience with undersized controlling apparatus has been dearly bought. The destructive arcing occurs when power is shut off through the blow-out effect of the magnet being not powerful enough to break the arc. This results in the arc going out only when everything within reach has been "chawed up," and things are so cramped of necessity in the best known controllers, that a lot of copper and iron are melted before this happens. It has been suggested that the insertion of a relatively high resistance in the first notch circuit may overcome much of this difficulty, and we believe that the maintenance of controllers in general, whether used with small or large motors, would be favourably affected by the adoption of this method. It is the ruling practice to make the first notch an accelerating position, but the above suggestion involves interpolating so much resistance that the torque would be cut down below the starting value. It is highly probable that this has been tried already by some engineers, but they are certainly exceptions to the rule, and we shall be glad to hear their experiences. Anyhow, now that the advantages accruing from reasonably speedy acceleration are accepted generally as outweighing the disadvantage of increased starting current, the practical loss of an accelerating position will not be considered a very serious one. The Americans have found that beyond a definite size of equipment the ordinary platform controller becomes too heavy to be manipulated with the requisite speed for breaking heavy arcs, and they are turning towards the multiple-unit train control type of apparatus, even for single cars, although the first cost is heavily in excess of the older type of controller.

The Parallel Operation of Alternators.

In another column we give an abridgment of Mr. Hopkinson's paper on the "Parallel Working of Alternators," read before the British Association. We are inclined to agree, as indicated in a leader in our issue of September 4th, with Mr. Kapp who, in the discussion, expressed the opinion that for successful paralleling of alternators the chief condition to be satisfied is the governing of the prime mover. It is quite right to take precautions against defective governing, but while taking these precautions, it cannot be too strongly emphasised that the governing of all the prime movers operating in parallel should be as nearly as possible identical, so that the forced oscillations may in each case be the same. If this point receives proper attention, there should be no trouble in the parallel running of alternators. Of course the designers of the alternators should see that the armature reactions of the machines are as nearly as possible alike.

THE GLASGOW MUNICIPAL TELEPHONE SYSTEM.—I.

Facts and Figures on Capital Cost.

After no little trouble and delay, we have succeeded in procuring a copy of the accounts and statistics of the telephone department of the Corporation of Glasgow for the year ending May 31st, 1903. After a careful perusal and comparison of the figures in those accounts and statistics, we can well understand the reasons for the unwillingness of the Glasgow Corporation telephone department, to circulate this interesting document among those capable of dealing with the figures from an expert point of view.

So much wild and superficial talk has been indulged in on the subject of telephone management and finance by town councillors and other advocates of the propagation of municipal telephony, and so many misleading figures have been put forward in municipal telephone estimates and accounts, that we think it is only fair, both to a great industry and to the municipalities themselves, to draw attention to the fallacies that have been indulged in, and to the specious figures by which they have been supported. For this purpose we could desire no better material than that afforded by the accounts and statistics of the telephone department of the Corporation of Glasgow.

We shall not meet with any dispute if we say that the cardinal principles on which municipal telephony rests are that the average capital cost of a working subscriber's line in a modern city telephone system is about £20, and that an average annual rate of about £5 is sufficient to pay for operating expenses, interest on capital, sinking fund to redeem capital, and all other charges incident to the conduct of a city telephone exchange system. It is not too much to say that the whole basis of municipal telephony rests on those figures. The blue book of the Glasgow inquiry of 1897 shows that the Glasgow Corporation pinned their faith absolutely to those figures in their frantic desire to plunge into a telephone adventure on a large scale. The blue book of the Parliamentary Telephone Inquiry of 1898 shows that the Committee over which the late Mr. Hanbury presided was largely influenced by those figures and by the estimates and statements put forward to support them. And the very Act of 1899, which made municipal telephony legally possible, may be said to be based on the theory that it was practicable to telephone a city at an average capital outlay of £20 per working subscriber's line and to operate the service with financial success at an average annual rate of about £5 per subscriber's line. Further, all the reports and estimates on which those municipal telephone systems now actually in operation or in course of construction are laid out, pin themselves to the figures we have named. Indeed, these estimates generally name somewhat lower figures for average capital cost per line, such as £18 10s. or £19 10s., but we have preferred to take £20, as being a neat, round figure, easy to handle, and having the advantage of giving the advocates of municipal telephony a liberal margin for contingencies. As to the estimates of revenue, we are, perhaps, cutting it a little fine in putting the figure at about £5, but while the estimates which have served as a guide to the Town Councils desirous of establishing municipal telephone systems have generally stated that an average revenue of £5 5s. or £5 7s. 6d. would be desirable to start with, they have also said that after a year or two an average revenue per line of £4 15s. or £4 10s. would suffice. So that an even £5 may fairly be said to be the guiding figure.

Now, the soundness of these figures and estimates has been disputed time and time again, and by telephone experts of ample experience, but so far the municipal estimates have carried the day. It now remains to be seen how those estimates have been justified by the actual results of municipal telephone working. The Glasgow system is the only municipal telephone enterprise having a record of a couple of years' service, as Glasgow has just published its second year's telephone accounts. Therefore Glasgow is obviously the best example that can be taken to test the reliability of the figures on which municipal telephony is founded. If the actual results of the Glasgow system after two years' working were found to justify the estimates on which the system was established, the advocates of municipal telephony might be entitled to

claim that they had proved their case by the best of all possible tests, actual working experience. But they do not. On the contrary, they prove in a remarkably complete manner, as regards capital cost, that all the criticisms made of municipal telephone estimates in the past have been founded on the most solid basis; and although they give no complete proof that the working expenses have been underestimated, inasmuch as there is no detailed statement of working expenses, there are good grounds for believing that the real working expenses have by no means been fully stated in the accounts, as we shall presently show. In speaking of working expenses, we are leaving on one side for the present the important item of depreciation, which, up to the time of the discussion of the accounts in the Glasgow Town Council last month, had been resolutely ignored by the Telephone Committee. At this discussion depreciation was a Banquo's ghost that would not down; and it has now received tardy recognition in the copy of the accounts before us by the impress of a rubber stamp which converts "General Reserve Fund" into "General Reserve and Depreciation Fund," the said fund amounting, after two years' working, to the magnificent sum of £2,092 9s. 7d.—about two-thirds of 1 per cent. on the capital cost of the plant!

One word more must be said by way of preface, and this deals with the important subject of surplus plant. One of the principal objections that has been made to the municipal telephone estimates is that they do not sufficiently take into account the necessity for surplus plant. It is a well recognised feature of telephone work that in a city telephone system there must, for various reasons, always be a large margin of plant not actually in use. This was pointed out most explicitly at the Glasgow Telephone Inquiry of 1897, in the evidence of Mr. Herbert Laws Webb, who stated that the usual margin of spare plant was about 35 per cent. of the whole, and gave as his opinion that the allowance made in the estimate for a Glasgow municipal system, put in evidence at the Inquiry, of a margin of only 20 per cent. of spare plant, was absolutely impracticable. The same point has been urged at other times, but the municipal estimates have steadfastly ignored it. The estimate for Glasgow on which the work was actually done, published in March, 1900, purported to provide for 5,250 metallic circuit subscribers' lines to cost £100,000, and 5,250 partially completed lines at £21,000, a total of £121,000 for 5,250 actual working lines. It is plain that the surplus plant provided for in this estimate is only a little over 17 per cent. of the total, a lower figure than that pronounced to be impracticable in 1897. The number of "partially completed" lines to be provided, has practically no meaning, because 5,250 "partially completed lines" at £21,000, works out at £4 per partially completed line. As the completed lines average over £19 a piece, the partially completed line is only one-fifth of a completed line, and would require an average expenditure of £15 to become a completed working line. Clearly, the number of "partially completed" spare lines is a minor point; the real point is the proportion of the total plant estimated to be spare, and this in the estimate for the present Glasgow plant was put at a little over 17 per cent. In the estimate for the municipal telephone system recently under consideration by the Hull Corporation, the proportion of the total capital cost allotted to spare plant was only 12 per cent., 600 "spare partially completed lines" being estimated for at £8 each, or £4,800 for spare plant out of a total estimated capital cost of £42,000 for a system of 2,070 working lines. At Hull the number of spare lines to be provided has gone down, and the amount of "partial completion" has gone up, as here the partially completed spare line is four-ninths of a completed line—the completed lines being put at the modest figure of £18 each. But the proportion of the total plant estimated to be spare is only 12 per cent., as against 17 per cent. at Glasgow. Either figure is unworkable and unattainable in a city telephone system, and it is largely the slight importance given to this vital question of spare plant which has caused the municipal telephone systems to fail to justify their case by working within their estimates.

If we include the spare plant in calculating the average capital cost per working subscriber's line, which is the proper way of using the figures, we find that the Glasgow estimate of 1900 works out at £23 1s. per line. The practice of putting the spare plant as a separate item is misleading, inasmuch as spare plant must always be carried and the revenue with which the charges on it are to be met can only be obtained from the working lines, since they are the sole source of revenue of a telephone concern. Each working line must carry a certain proportion of spare plant, and each working line must not only pay its own way but also that of its share of spare plant; therefore the estimating of the spare plant as a separate item, giving the idea that it can be brought wholly into use at a fixed price to give a fixed additional working capacity, is most misleading and has partly helped to give currency to the delusive figures on which municipal telephony so largely relies. The whole capital cost divided by the whole number of completed lines provided is indubitably the correct way of arriving at the average capital cost per subscriber of a city telephone system. At the very beginning this would give exaggerated figures, but when a system has been working for two years, and has practically caught up with its orders, this method gives a correct index of the average capital cost per subscriber's line.

The Glasgow municipal system has been working for two years, and has spent £270,938 for 7,441 actual subscribers' lines. Deducting the value of certain extension instruments and private lines, amounting to £11,194, the capital represented by the 7,441 actual subscribers' lines is £259,744, which works out at £34 18s. per line; this is including spare plant. The estimated cost, including spare plant, was £23 1s. per subscriber, so that the actual cost per subscriber's line has been £11 17s. in excess of the estimate, or a total for the 7,441 lines of £88,175 17s. If we exclude the spare plant, the difference is somewhat less startling, but still not at all a figure to be sneezed at. Excluding spare plant the original estimate was £19 1s. per completed subscriber's line. In the accounts now under review, it is stated that "the amount of capital invested in works not yet earning revenue is £59,096." Curiously enough, this works out at exactly £8 a piece for 7,387 "partially completed lines" (mentioned in another part of the report), £8 being the standard municipal figure for that vague entity, a "spare partially completed line." Deducting the £59,096 from £259,744, we get £200,648, which gives an average of £26 19s. per line for the 7,441 working lines. This is £7 18s. per line, or a total of £58,897, in excess of the original estimate. A total of 7,441 working lines at the estimated cost of £19 1s. per line should have cost only £141,751, instead of the £200,648 actually expended. And it will be noted that in the original estimate provision was made for partially completed spare lines in exactly equal number to the working lines, but to average only £4 each; the accounts show that the actual number of partially completed spare lines is almost exactly equal to the number of working lines—7,387, as against 7,441—but the average cost is double that estimated, £8 instead of £4. The real excess over the original estimate is therefore the figure first stated, £88,175.

The following table will show how the figure of 7,441 working subscribers is arrived at, in place of the figure of 9,122, used in the Glasgow Town Council discussion. This latter figure really represents, as we suggested in a leading article a few weeks ago, not lines, but instruments, a very different matter. The statistics given in the official statement accompanying the accounts regarding the manner in which the total of 9,122 is arrived at are these:—

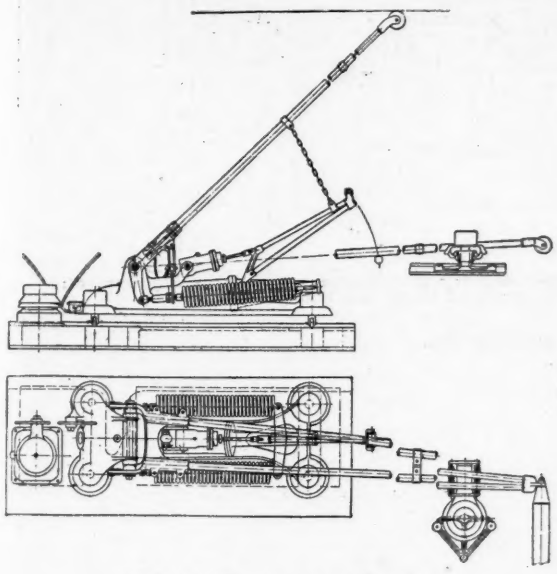
Number of Lines in Operation.

1. Direct lines to the Exchange, Tariff No. 1 ...	7,019
2. " " " " " No. 2 ...	303
3. Party line	13
4. Public telephones	115
5. Service telephones	60
6. Extensions outside	611
7. Extensions inside	811
8. Private lines	184
9. Sundry lines	6
Total... ...	9,122

In this table the items that mean subscribers' lines, of the kind contemplated by the estimates, are 1, 2, 3 and 4. It is clear that all the figures relate to instruments, or "stations," as they are more usually termed, and the party lines presumably have three or four stations on each, so for

the 13 party line stations we take four lines. We then get for actual lines:—

Direct lines, No. 1 tariff	7,019
„ 2 „	303
Party lines	74
Public telephones	115
Total direct exchange lines	7,441

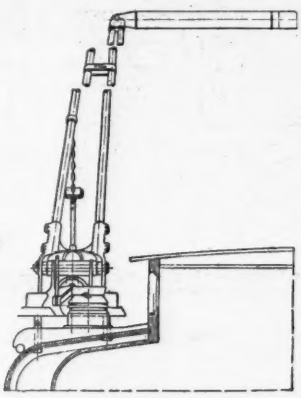


Plan and Elevations of Trolley.

The "service telephones" and "sundry lines" may be disregarded; they bring in no revenue, and probably mean only instruments used in the offices of the telephone department. We now have inside and outside extension stations and private line stations to consider. An inside extension instrument is usually but a short distance from the main instrument, and 25s. should easily cover the average cost of the wiring. Putting the instrument complete at £2 15s., a total of £4 amply represents the capital cost of an inside extension. For an outside extension, £10 is a liberal figure, as these lines are usually short; and although an occasional long one occurs, the general average length of such lines is much less than that of the subscriber's exchange line proper. For the average capital cost of an outside extension, including instruments, £10 is therefore an outside figure. The same figure may be taken for the private line stations. Each station here represents only half a line, as the private lines requires at least two instruments to make it effective, so that £10 per instrument more than represents the capital value of the private lines. We, therefore, have for the minor items in the list:—

811 inside extensions at £4 =	£3,244
611 outside „ „ at £10 =	6,110
184 private line stations at 10 =	1,840
Total	£11,194

Deducting this sum from the total capital cost of £270,938 we get £259,744 as representing the actual lines, and this works out, as stated above, at £34 18s. per line, which is the real average capital cost per subscriber's line of the Glasgow Corporation telephone system.



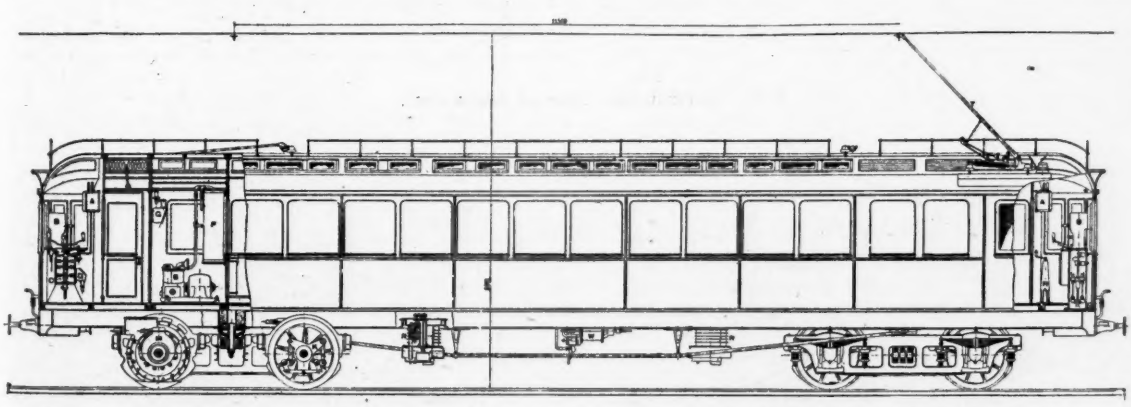
THE VALTELLINA ELECTRIC RAILWAY.

(*Concluded from page* 547.)

The adjoining figures show the arrangement of the trolley; the air cylinder, by filling which the trolley is raised, is partly covered in the plan by the buffer cylinder. The springs, which are connected to a cross-beam bearing upon the plunger of the air cylinder, are only in tension when the trolley is raised, and any failure of the air pressure allows the trolley to fall, isolating the car from the high-pressure lines. The trolley base is provided with a horn arrester to prevent lightning discharges from passing inside the driver's cab. As shown in the following views of the motor-car and locomotive, each trolley is normally used for travel in one direction only, though both or either can be used if necessary; the rollers make good contact with the trolley wires, in spite of the fact that, theoretically, contact takes place at a point only, and though there is some sparking at high speeds, the rollers suffer but little wear.

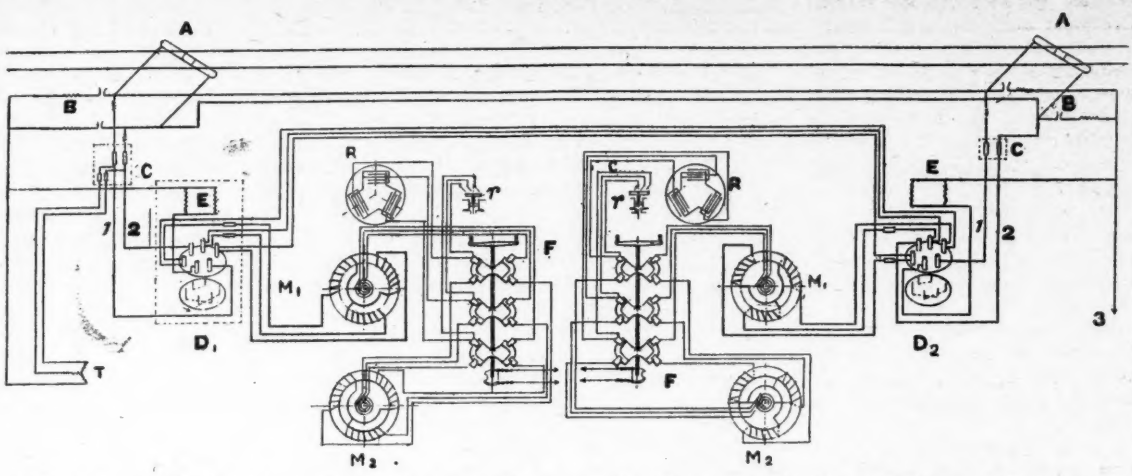
We give illustrations showing the construction and arrangement of the motor-cars and locomotives, with diagrams of the connections of the wiring. The motor-cars, as already explained, are equipped with primary and secondary motors on the cascade system, each bogie truck being fitted with two gearless motors; the stator is carried in the truck with spring suspension, and is journalled upon the rotor, which has a hollow shaft concentric with, but having considerable clearance from, the axle of the wheels. The torque of the rotor is communicated to the driving wheels by means of well-lubricated links, which allow the axle to oscillate over a range of nearly 4 in. without affecting the rotor. The whole of the weight of the motor is spring-borne. The wheels are 1·17 m. in diameter, and the wheel-base of each truck is 2·5 m., while the distance between the two bogie-pins is 11·5 m. The total weight of the car is about 53 tons.

Under the body of the car will be seen the rheostats in



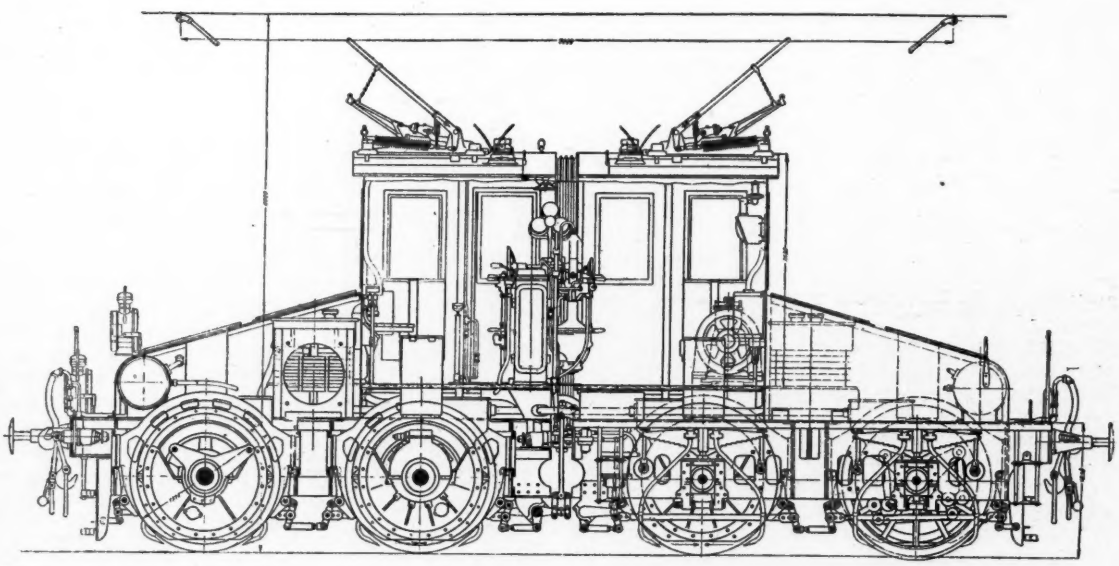
A, Safety fuse; B, Main switch; C, Controller; D, Connection box; E, Air-compressor; F, Air reservoir; G, Governor for air pressure; K, Driving links M, Motor; R, Rheostat; W, Air-brake cylinder.

Elevation of Motor-Car.

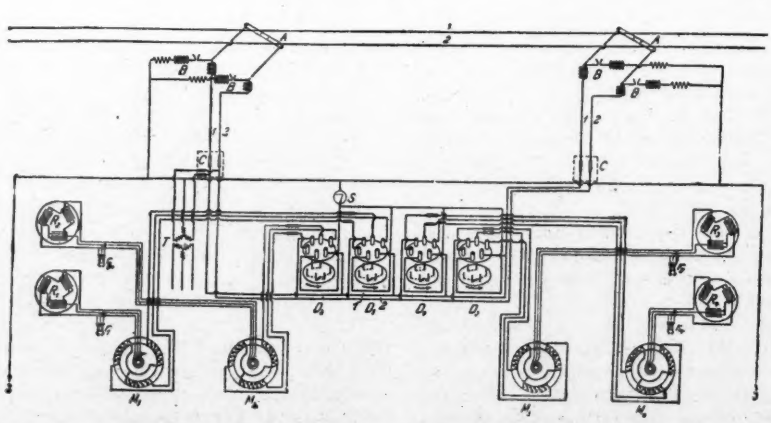


A, Roller trolley; B, Lightning arresters; C, Connection box; D_1, D_2, High pressure main switches; E, Circuit-breaker; F, Controller; M_1, Primary motor; M_2, Secondary motor; R, Rheostat; r, Short-circuiting device; T, Transformer; 1, 2, High pressure lines; 3, Earth line.

Diagram of Connections of Motor-Car.



Part Sectional Elevation of Locomotive.



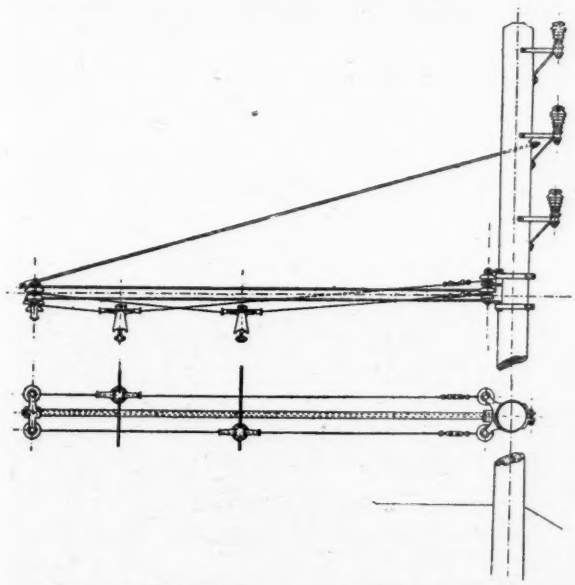
A, Roller trolley B, Lightning arresters; C, Connection box; D, High pressure main switches; M_1, &c., Motor; R, Rheostat; r, Short-circuiting device; T, Transformer; 1, 2, High pressure lines; 3, Earth line.

Diagram of Connections of Locomotive.

section and elevation; these consist of iron plates of special shapes, suspended in tanks communicating with reservoirs filled with a solution of carbonate of soda in water. When air under pressure is admitted to the reservoirs, the liquid is driven up into contact with the plates, thus gradually decreasing the resistance between them.

The controlling gear, which we have already described, is duplicated in both driver's compartments, the whole equipment being operated from either end of the car. The motors exert an aggregate power of 300 H.P. while accelerating in cascade, and can be loaded to 400 H.P. if necessary; the primary motors alone, when running at full speed, are similarly rated at 150 H.P. each, or 300 in all. The motor-car can haul a train weighing 70 tons at a speed of 70 km. per hour, taking a current of about 30 amperes at 3,000 volts.

The locomotives, being designed for heavier loads and lower speeds, are mounted on bogie trucks with wheels 1·396 m. in diameter, each truck being provided with a pair of motors of 250 H.P. each, which are not operated in cascade. The electrical equipment is similar to that of the motor-cars, save for the modifications entailed by this fact, and the concentration of all the controlling gear in a central driving cab. The locomotive body is in two parts, coupled



Detail of Bracket Suspension of Trolley Wires.

together at the middle. The wheel base of each truck is 2 m. long, with 4·63 m. between the bogie pins; each locomotive weighs about 46 tons, and is designed to haul a load of 200 tons up an incline of 22 per cent., running at a speed of 30 to 35 km. per hour, and taking a current of about 60 amperes. Although the controller is not duplicated, each of the regulating handles is repeated at either end of the cab, which is 12 ft. long, so that the driver may retain full command of the mechanism while travelling in either direction. Each of the four motors can be independently operated as required.

The line is worked on the Webb & Thompson staff system, with an electrical block, ingeniously interlocked with the station circuits. As previously explained, the overhead gear at a station is always separated from the rest of the system, and the switch by means of which it is coupled to the live sections is electrically connected with a staff-holder on the station platform. Unless the driver takes his train staff out of the holder, he cannot get power to start the train. There is such a holder at either end of each block section, and these holders are connected together by an electric circuit. Unless all of the staffs belonging to one section are in one or other holder, no matter which, a staff cannot be removed from either holder, and the driver cannot proceed; the staffs belonging to any one section are also constructed so that they cannot be inserted in any holder save those on the same section. A driver arriving at a station, if he is able to withdraw one of the staffs, may go on, certain that the line is clear; otherwise he can neither withdraw a staff nor start his train.

The capital cost of the whole of the electrical undertaking has been about a quarter of a million sterling; of this amount, £100,000 has been spent upon the hydraulic works, which are designed for three times the power at present utilised. The electrical rolling stock cost about £52,000 and the equipment of the line £68,000, the remaining £28,000 being laid out upon the generating plant. The total cost per mile is about £3,700, but if allowance is made for the, at present, excessive size of the power plant, the cost is stated to be about £2,000 per mile. In this, of course, no account has been taken of the cost of the permanent way, or that of the old rolling stock which has been utilised. As regards the working results, it is claimed that the energy consumed amounts to 33·5 watt-hours per ton-mile, a very economical return. The total working cost amounts to £2,700 per annum, or 10·125d. per 1,000 ton-miles, compared with a fuel cost of 3s. 1d. for the same work before conversion.

When interest on capital is taken into account, allowance being made for the fact that only a portion of the plant is in use as yet, and when depreciation is provided for, it appears that the cost per KW.-hour amounts to 0·94d., and per 1,000 ton-miles to 31·5d.

It has already been mentioned that important extensions are in hand, connecting the electrified system with Milan and Como; and we may remind our readers that four new locomotives have been ordered from Messrs. Ganz & Co., which are to be capable of exerting a tractive effort of 8,000 to 12,000 lbs. at a speed of 40 miles per hour, or 14,000 to 22,000 lbs. at 20 miles per hour. These locomotives, it is claimed, are the largest in the world, and sufficiently indicate the capabilities of electric traction with three-phase currents at high pressure.

CORRESPONDENCE.

L.C.C. Engines.

May I comment on your criticism upon my letter of last week in regard to one or two points you now raise. First of all you convey the wrong impression that I advocated cotton mill precedents, simply because I quoted a single case of something done in a Lancashire mill.

Secondly, in case of sudden loss of load, the cause will be serious enough to demand, not governing on the L.P. cylinder, but cut out of the condenser if the fly-wheel does not keep speed within bounds sufficiently narrow. Such large engines on traction work, and working several routes, do not lose load suddenly except by special cause, which would warrant this method if simple H.P. governing and fly-wheel effect failed to suffice. I must adhere to my contention as to boiler arrangement.

As regards horizontal engines, I have no predisposition in their favour either from training or otherwise, having made vertical engines in the days when the horizontal engine was looked on as an interloper. I am satisfied that the horizontal engine, however, has advantages not possessed by the vertical type of to-day, that for second stage expansion, its chief disadvantages disappear, and that good constructors can build it to give better satisfaction than you appear to think possible. I object to the classification of the combined vertical and horizontal engines as American. The arrangement of engines at right angles working a single crank, dates back long prior to the electrical period, and was familiar to steam engineers in the last century.

Finally, and not for any personal hurt, I do object to the further promulgation of the false idea that mechanical engineers have hazy ideas of the requirements of electrical work. We all of us have the benefit of the best assistance of our electrical brothers.

The idea of the electricians in the past was, I know, that there were unknown terrors in electricity. We heard much nonsense about enormous stresses to be provided for, and we looked on amused at the toys which the electricians provided to deal with them. The Americans bluffed the position, and got in here on the same false basis of enormous and unknown factors which they cleverly imposed on people

here who were foolishly guided by the arguments you now again put forth. Thus it was that so many American engines came over here of a design and strength that were ridiculous had the assumptions of electricians been true. At one time these false assumptions were extended to the simplest tramway work. Yet the easiest going traction station I ever saw has horizontal engines roped to two-pole dynamos in a manner that certainly would not pass muster with even a Lancashire rope-driving expert.

It is one of the oldest traction stations in this country, and has not even a fly-wheel on the generators, which was a common electrical engineer's mistake, and not a mechanical engineer's blunder. To get a fly-wheel effect upon the dynamo the direct connected system was, perhaps, brought out. Probably it was better to bring the generator to the fly-wheel than to take part of the fly-wheel to the generator. But this station remains to-day as a piece of work that, while not meeting the views of mechanical engineers, is composed of parts in which no difference was made on account of electrical terrors.

I fail to understand the reference to the difficulty of balancing reciprocating parts. The reciprocating parts, as you rightly say, move in planes at right angles. They are, therefore, almost completely balanced by a fan-tail crank. It is the cylinder arrangement best suited for this perfect system of balancing, and for such moderate speeds as 125 r.p.m. the small difference between the plane of rotation of the crank tail and the plane of motion of the parts to be balanced is immaterial.

Absolute balance of each engine can be made by accessory weights in the fly-wheel, and this can be done for the vertical cylinders without disturbance of rotatory balance. The residual effects at such low speeds are not worth consideration if the rotary balance is to be regarded as essential.

The turbine may be everything that is claimed for it. It has certain peculiar advantages, but it falls very far short of what these advantages should enable it to perform, and though it is a big step forward in one direction, it is a step back in others, and it is far from being so perfect as to warrant wholesale adoption in large and important work without careful consideration and suitable other circumstances.

W. H. B.

[We do not wish to prolong this discussion, but one or two remarks in the foregoing letter seem to call for notice. We strongly object to the suggestion that electrical engineers conjured up bogies about "enormous stresses," and so on; it is true that American engine builders propounded theories of this kind, but they were promptly exposed by British engineers and technical journals, ourselves included. Had British mechanical engineers turned their attention at an earlier date to the splendid market arising for large engines for electrical power generation they would have secured the orders which were placed abroad. This reproach, however, has happily ceased to be justified. What rope-driven traction generators and similar old-fashioned ideas have to do with the matter in hand, we cannot conceive.

Our correspondent again ignores the fact that reciprocating parts cannot be balanced by revolving weights; and his alternate commendation and condemnation of the turbine lacks point.—Eds. Elec. Rev.]

Curious Earth Readings.

We have an earth recording meter working on a three-wire system in a large power and lighting installation, which gives a very steady chart. We are able to shut down our own power house and get current from the "Corporation's" outers (460 volts) running our own balancer for lighting; when, however, this is done we get a very strange chart, fluctuating the whole time.

The automatic cut-out for the recorder is out the greater part of the time (being over 5 amperes recorded), but on putting a lamp in series we are surprised to find that it will not light or even glow, having tried 50-volt, 100-volt, and 230-volt lamps. Another peculiar thing is that the magnet of the automatic cut-out gives a hum similar to the hum of the machines at the Corporation station. The armature for this magnet when lifted slightly chatters, as though being attracted by an alternating current.

By connecting a telephone between the telephone earth plate and our own earth plate (of the system) this alternation is very distinct. The Corporation electricity works is about 1¼ miles away.

When we change over on to our own generators, all is again normal. Why is this?

W. M.

Gas Engines for Power Stations.

I note with pleasure your leaderette *re* the above in the current issue.

It is astonishing, the amount of prejudice some engineers display towards gas engines for central station work, and I believe that if some of these gentlemen would only take the trouble to thoroughly investigate the matter and see for themselves some of the satisfactory installations which are now running, they would be convinced of the merits of gas engines.

No doubt there have been several instances in which the adoption of gas engines has proved a failure, but is not this often the case when a new method or system is tried, and is this any reason why engineers should decline to try again? For instance, at Walthamstow there is a fair size gas engine plant, and anyone seeing the particular type of plant in use there for the first time will be astonished at its silent and smooth working, equalling as it does the best steam plants in this respect. There is no doubt that the plant there does the engineers considerable credit, at any rate, so far as one can judge from the financial statements recently published.

It is to be regretted that the price of the high-speed gas engine is considerably more than that of an equivalent steam plant. There is no doubt, however, that when the demand becomes greater there will be more competition and a consequent lowering of prices.

If the advantage of small initial cost could be added to the low running expenses, gas engines would, I feel sure, be extensively used in power stations, as then the total cost of plant per KW. installed should be very much lower than that of steam.

Wm. J. U. Sowter,
Borough Electrical Engineer.

Dorchester, *October 2nd*, 1903.

Smoke Abatement.

Unbiassed engineers will agree with your correspondent in the current issue in approving of the action of local authorities in imposing fines for black smoke.

That there is a remedy for this has been proved in thousands of instances where mechanical stokers have been successfully adopted, and with the further result that a great saving of fuel and labour has been effected. There can be no question as to the utility of mechanical stokers properly worked. The conditions under which it is necessary to supply fuel to boiler furnaces, and at the same time to utilise its full calorific value, and this with a total absence of black smoke, are such that it is impossible to satisfy them by the most careful hand-firing. The fuel must be added in small quantities and at frequent intervals, and the air supply must be adjusted to the rate of combustion, conditions which cannot be met except by mechanical means.

So far, perhaps, we are agreed, but a very recent instance regarding "Whittaker" stokers will at once dispel its claim to infallibility put forward by your correspondent.

Within a few minutes of reading Mr. Ashworth's letter, I was informed directly by the manager of one of the finest mills in Lancashire that they had ceased to use Whittaker's stokers, as they had utterly failed to accomplish their mission, and what was claimed for them by the makers, and that better results, both as regards fuel consumption and prevention of smoke, were now being obtained by ordinary hand-firing.

My daily avocation brings me in constant touch with large steam users, and if the doctrine of the "survival of the fittest" holds with regard to mechanical stoking, then certainly Whittaker's must take a back seat. I could refer him, for instance, to the "Bennis" stokers, which one seems to meet constantly, and which I believe really accomplish

all that is claimed for them, and that is a good deal more than what is claimed for Whittaker's. Only last week I was at a place where these stokers had been in use over 10 years, and they informed me the upkeep had been under a sovereign for each boiler per annum, and that all the parts had kept in good condition.

Personally, I do not see how it is possible to keep a smokeless chimney with a stationary bar; as the fire gets clinkered up the conditions are bound to alter, and if the same amount of coal has to be burned to keep up the steam, with less air admitted through the fire, black smoke is bound to result.

As to the question of forced or induced draught, this is, in many cases, absolutely necessary, especially where low-class fuel is burned, or when a maximum amount of fuel has to be consumed per square foot of grate surface per hour; or, again, as in central station work, where the peak of the load is so much above the usual working conditions as to require, for a short time an abnormally large amount of steam, it is absolutely impossible, in thousands of cases, to meet the conditions present, except by the adoption of forced draught, and many Corporations have been able to solve a great difficulty as regards steam raising and effect a great economy by the adoption of mechanical stoking, and forced draught, and self-cleaning fire bars. In fact, the exceedingly low coal cost of some of the central stations, about ·30d. per unit, is entirely due to their adoption.

W. Banks.

Bolton, *October 3rd*, 1903.

I fear both your correspondents, in reply to my letters, are erring, as they appear to be advertising other people's patents, which was not the object of my letters.

I agree with Mr. Deane as to the great importance of regulating the supply of air, as the supply depends entirely on the class of fuel used, a bituminous coal requiring more oxygen for its combustion (if you wish to do away with smoke) than a semi-anthracite or anthracite.

I do not agree with him in supplying air *under the grate*, as this is the chief reason why the various forced draught systems have utterly failed, because the air in passing between the fire bars through the fuel on the grate, is deprived of its oxygen before it reaches the bridge, and it cannot, therefore, support combustion *behind* the bridge, where the gases are; *alias* it attempts to consume the gases before they are actually produced, which is obviously absurd.

To consume these gases, one must remember you can only do it when they are at their highest temperature (the temperature of ignition), which is immediately behind the bridge, and it is only there you can do it, *if* you can bring in the highly-heated oxygen, at such a temperature that it will chemically unite with these volatile carbonaceous gases before they cool down, carbonise and turn into smoke.

In reply to Mr. Ashworth, I do not see the gist of his remark, when he states, "But if it can be shown that there is a remedy, I suppose he would continue fining them." Naturally I would if they did not use the remedy.

What would be the good of the test, except to show the steam users the remedy, and what is the good of a remedy if they did not make use of it, and what is the good of a fine except to enforce the remedy?

I agree with him respecting moving and rocking bars being no good, and as for steam jets, more harm is done than one would imagine. They pull down the temperature of the furnace as well as the steam pressure, and corrode your boiler plates.

Sprinkling stokers are far too elaborate and expensive for practical use, and, like other stokers, do not consume smoke, but minimise it. If you wish to force your boiler, supposing you are hard pushed for steam, and sprinkle on a bit more coal than usual, smoke is produced at once; this is the case with *all forms* of automatic stokers.

No doubt a lot of unnecessary smoke is caused by bad hand stoking, and could be prevented. The majority of stokers, especially the lazy ones, put about eight or ten shovelfuls on at a time, either just inside the furnace door or in a pile in the middle of the furnace: such stoking causes a good deal of unnecessary smoke, lowers the temperature of the furnace excessively, and is not conducive to economical combustion. Stirring a green fire with a rake is another form of bad stoking. To stoke effectually for anthracite coal, it should be from 4 in. to 6 in. thick evenly all over the fire bars, so as not to allow cold air through the bars at any part, and to distribute the heat evenly all over the plates. In the case of bituminous coal, from 7 in. to 15 in. thick, according to the nature of the coal and the available draught.

If steam users would only remember that when he sees dense black smoke rolling out of his chimney, that there is as much waste going on as if he were to throw his coal out in the road, he would see that his men are stoking properly for his *own* benefit, and *certainly* to the benefit of his neighbours.

E. A. S. Daniell.

Coal Scales for Power Stations.

With reference to the description of the above in your issue of the 2nd inst., I would be glad to have some further information on the subject.

As an engineer directly concerned in all matters connected with the handling of coal, and particularly with boiler feeding, I must confess that I cannot see how it is possible by the arrangement described to obtain anything but a very approximate idea of the weight of coal delivered.

As far as I understand it, the apparatus requires to be set to deliver a *given weight of coal*, and is so arranged that when that weight has accumulated the load is discharged, and I presume a counter registers the number of operations.

It would seem obvious that if "the scale is fitted with double shutters to control the coal supply, and so work that large lumps of coal can be passed into the weigh hopper," then if a lump *does* or does not pass, the weight will be greater or less by the mass of that lump, unless some provision is made for cutting the lump into the requisite size to accord itself with the balance, which of course is impossible.

No doubt, with an even arm beam, a fairly accurate balance can be obtained (in fact there is no reason why it should not), but, as I take it, the very action of balancing, or rather overbalancing, is used to perform some mechanical operation necessary for cutting off the supply from the bunker above, and the opening of the delivery doors or shutters, so that, to the ordinary engineer, it would appear improbable that anything approaching exactitude could be obtained.

My attention has lately been drawn to a weighing apparatus for a precisely similar purpose to the one you describe, but the arrangement is such that the *actual load* in the weigh hopper is weighed and recorded, and not a pre-arranged quantity.

I can understand and appreciate this, but, as I said before, I cannot grasp the other. Perhaps you will enlighten me.

F. A. Yerbury.

REVIEWS.

Physico-Chemical Tables for the Use of Analysts, Physicists, Chemical Manufacturers and Scientific Chemists. In two volumes, each complete in itself. By JOHN CASTELL-EVANS, F.I.C., F.C.S., Superintendent of the Chemical Laboratories and Lecturer on Inorganic Chemistry and Metallurgy at the Finsbury Technical College. London: Charles Griffin & Co., Ltd. Vol. I.

Finsbury Technical College has produced from amongst its staff quite a "galaxy of literati." To the books of Prof. S. P. Thompson and Prof. J. Perry has now to be added one which certainly gives new glory to the constellation; and although it hails from the chemistry region, it casts light upon every department of quantitative research, both in practical and theoretical physics and in chemistry. Volume I. is devoted to Chemical Engineering and Physical Chemistry. The book consists of a series of tables of formulæ and figures, calculated or compiled from British and foreign sources, collected, concentrated, arranged, classified and checked by the author, Mr. John Castell-Evans, and presented in a form which of necessity will be of great utility alike in the laboratory and the works. We know of no such

compilation in any language. There are excellent books in German dealing with some of the data; but so far as our acquaintance with books goes, there is nothing of so comprehensive a character as this. Part I. is Mathematical; besides giving the usual arithmetical and algebraical formulæ of various series, and a useful set of differentials and integrals, it supplies us with tables of values worked out for special cases. For example, in the calculations of values of $\frac{n}{1-n}$ for use with a slide-bridge, all values of n from 0·001 to 0·999, are given. Similarly for $\frac{m^2}{1-m}$, $\left\{\frac{n}{100-n}\right\}^2$, $\frac{(n^2-1)}{(n^2+2)}$, n, n^2, n^3, $\frac{4}{3}n^3\pi$, and various other expressions, tables for successive values of the variable are provided. Weights, measures, and conversion factors follow. This part also contains logarithmic and trigonometrical tables and tables of powers. Of necessity, these latter tables are put in a somewhat condensed form, and it is doubtful whether they might not almost have been omitted. Every devout student of the subjects here dealt with has his own logarithm book and Barlow's tables, and would probably prefer to use these for ordinary spade work, reserving his Castell-Evans for special functions and constants.

Part II. is concerned with mechanics, and contains the information usually sought for in Molesworth, presented in a manner which appeals to the rationality of the reader rather more than do the usual run of pocket-books. This part contains some useful data in regard to wire, but beyond that it does not strike us as possessing special value for the electrical engineer.

Part III., which treats of data relating to Physics and Physical Chemistry, constitutes the book proper. It includes tables of coefficients, correction factors, and physical and chemical constants, covering a wide field of thermometry, melting points, comparative changes of volume with temperature, calorimetry, density, barometry, thermal constants of gases, reduction of weights in air to weights in vacuo, vapour densities, and an elaborate set of tables of vapour tensions and boiling points for chemical substances. It is clear that this portion of the work has been derived from the latest and best determinations, the tables being for the most part computed by the author from the original experimental data. In most cases the name of the experimenter is given. The only serious omissions that we can detect in these tables and formulæ, are such as relate to platinum thermometry, as developed by Callendar and Griffiths, and in congratulating Mr. Castell-Evans upon Vol. I., we trust that he will find a place for advanced platinum thermometry in Vol. II.

Switchgear Construction—Elektrische Apparate für Starkstrom. By Georg S. Erlacher. Hannover: Gebrüder Jänecke. 1903.

The present volume is an attempt to deal with the design and construction of switchgear and switchboards from a scientific engineering point of view. Many firms in the past who would never have dreamed of turning out a mechanically bad dynamo, motor or engine have yet manufactured the most unmechanical switchgear. Whose fault this may be, it is, perhaps, difficult to definitely settle. This much is, however, certain, that the standpoint from which this work has been regarded has been the wrong one, and manufacturing firms are only now discovering that just anything will not do for switchgear, but that its design to ensure proper and economical working should be as carefully considered and worked out as any part of the generating plant. It is to be wished, however, that the author, before writing this book, had gained a wider knowledge and experience of modern practice than he evidently possesses. We welcome the book, therefore, chiefly for the spirit in which it is written, and will endeavour to indicate one or two points in which it needs correction and addition.

Chapter I. is devoted to switches, and commences with a record of the results obtained by the author on surface contacts, &c., and gives also tables of current densities adopted by various manufacturers. One result obtained is that, with good ground-in copper spring contacts, a current density of 0·1 ampere per square millimetre, a minimum pressure of 0·3 kilogramme per square centimetre, and a specific drop of 0·04 volt can be assumed. The specific volt drop is defined as the volt drop divided by the current density. Working the above out for a 2,500-ampere spring contact, we get (at 65 amperes per square inch, which corresponds to ·1 ampere per square millimetre) a volt drop of ·004 and a loss of 10 watts, which is about right. With copper brushes, however, the author gives a specific volt drop of 0·025 with a current density of 0·4 ampere per square millimetre and a minimum pressure of 2 kilogrammes per square centimetre. This works out with a 2,500-ampere brush contact to a volt drop of ·01 and a watt loss of 25, which is excessive. In fact, experience has shown that a brush contact is, if anything, better than a spring contact as regards watt loss. The author gives a pregnant example in page 10, which illustrates the importance of this, at first sight, seemingly trivial subject of good switch contacts. The volt drop across a 100-ampere contact was measured and found to be 0·0227 volt, corresponding to a loss of 2·27 watts. This was now ground in with powdered glass and oil, and the volt drop was reduced to ·0097 volt. Assuming a D.P. switch with four such contacts, and that it is in use at full load 10 hours a day for 300 days in the year, and that the cost of electricity is 8d. per unit, the cost of energy wasted during the year is 18s. 10d. in the first case and 8s. 1d. in the second. The grinding-in thus saves 10s. 9d. per year for this one 100-ampere switch alone. Reckoning 8d. per unit is, of course, too high; still, the example shows the importance of the subject when big currents come to be used. It must be remembered, too, that both the above-mentioned contacts (before and after grinding-in) would be reckoned good if tested by putting one's hand on them, as both ran perfectly cool. Besides the general remarks as to contacts, &c., various types of non-automatic switches are described and tables of dimensions given. The reader will, however, search in vain for reliable information on up-to-date constructions. For instance, on page 36 the author couples oil-break switches, and switches in which the arc is extinguished in a vacuum, together, and says that he has no information as to the action of such switches. As regards the oil-break switch we advise him, if a second edition be contemplated, to make inquiries of modern plants, when he will find that a great deal of experience is available. In fact, the only reliable switch for high pressure alternating current circuits is the oil break, and the use of the various air-arcing switches that are described, on such circuits, is very much to be deprecated. The above remarks also apply to Chapter II. on fuses. On page 109 a description of a return current cut-out designed by the author is given. It is not mentioned, however, that the construction is of very little use, as the amount of reverse current at which it operates is dependent on the voltage of supply. Should this latter drop, as it most likely would do with a reverse current, the current would become very high, and would very likely cause damage. Elaborate calculations are given on the magnetic circuits of automatic switches. We doubt whether these are of much practical use. In the majority of cases it is quicker to directly experiment to determine the windings necessary. Of course, the experimenting can be done much better if the principles enunciated are kept steadily in mind.

The remaining chapters are devoted to accumulator switches, rheostats and switchboards. The chapter on rheostats contains several graphical methods for the design of shunt regulators, &c., which will be useful to the designer.

In conclusion, we recommend the book especially to draughtsmen and calculators in the drawing office. The study of the volume will broaden their ideas and help in other ways.

Advance in Rubber.—The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., notify that a further important advance in prices of crude rubber having taken place, they are compelled to raise the quotations for their manufactures in proportion, the advance to take effect from October 5th. Revised prices are in course of preparation.

FIRST AIDS AND APPLIANCES.*

By J. D. M'GOWAN, M.D.

I believe that this is the first time in the history of this Association that any paper pertaining to relief of the injured has been read at its meetings; and it is one of the gratifying signs of the times that the interests of others than the members of the medical profession are being awakened to measures, not only for the prevention of disease, but also for preventing, so far as it is possible to do so, some of the unfortunate results of either improper treatment or no treatment at all in cases of accident, whether of a serious or an apparently trifling character.

Owing to the prompt application of first dressings in the late war between the United States and Spain, the records of the surgical department of the army and navy show a smaller percentage of loss of life or limb than in any previous campaign.

As all, or nearly all, of your shops are in large cities and towns where the services of a surgeon can be readily obtained, and no great amount of time need elapse from the moment of accident to the obtaining of skilled surgical aid, I will not go into an elaborate detail of all that should be done, as it is far better to do too little than too much.

If your shop is in Pennsylvania, you may have in your employ a young man who has a brother practising medicine in Iowa, and such relationship is apt to make him believe he has the medical instinct which gives him a knowledge superior to his fellows. If you have such a man about, and an accident happens, send him for a doctor.

It is well to have on hand at all shops or factories a box containing the necessary articles for the application of first aid and have a few of your intelligent foremen instructed in their use.

When an accident happens:

Do not get excited.

Send for a surgeon; tell him briefly the nature of the injury.

Remove the injured man to a quiet, well-ventilated place, neither hot nor cold, away from the noise of the engine room and machinery, and place him in as comfortable a position as possible; lay him upon his back, with his head on a level with his body, and his limbs in a natural position.

Allow nobody near except those who are needed to care for him.

Do not let him know that his condition is serious; encourage him all you can.

If the head has been injured, it should be raised somewhat higher than the rest of the body.

Loosen his clothing at neck and waist; if patient faints, lower his head and raise his feet.

If arm or leg is injured, it may be slightly raised and laid on a cushion; a cushion may be made with old clothing or any soft material.

If he vomits, or tries to do so, turn his body on one side, with the chin low, so that the contents of the stomach may flow from the mouth.

If the wound is found covered by clothing, cut the clothing in the seam and remove only enough to show the wound. In case of burns, pour lukewarm water over the clothing before attempting to remove it; otherwise you are liable to pull off the charred skin and leave a large, raw surface open for infection. Cover all wounds and burns as quickly as possible.

In examining a wound, wrap some antiseptic gauze around the fingers before touching it. Do not attempt to cleanse a wound; expose it and apply some antiseptic gauze, or the contents of this little package, called "first help for wounds," and wait for the surgeon to cleanse the parts.

Bleeding.

From the arteries, blood is bright red and comes in spurts or jets, as from a small hose. This should be immediately stopped if possible, and the best method is to apply pressure over the artery at some point nearer the heart than the point of bleeding, selecting a place where the artery is near the surface of the body. First, apply several thicknesses of gauze over the wound (having fingers wrapped in a separate piece of gauze before handling), and bind tight with roller bandage; then cover the point selected between the wound and the heart, apply pressure, using anything at hand for the purpose—a piece of rubber tubing, such as is used for gas piping, is best, a pair of suspenders, a rope or a bandage; bind the parts tightly, and leave them until the aid of a surgeon can be obtained.

From the veins, blood is of dark red colour, and flows out or wells up freely from the wound. Apply pressure directly over wound, using wad of gauze and bandage.

When the blood oozes from the wound, apply gauze and bandage.

In case of bleeding, keep the patient in a horizontal position; if bleeding from a limb, elevate the limb; keep the patient warm. When bleeding has ceased, hot drinks may be given.

Do not leave tight bandage on a limb too long; the bandage may be loosened after 15 minutes and reapplied with diminished pressure. In rupture of varicose veins, elevate the limb, loosen clothing, and bandage firmly below the wound and apply a compress over the bleeding vein.

When a man faints from loss of blood, lower the head and raise the limbs; be ready to apply compress, if bleeding starts up again.

Do not cover a wound with any dressing that is not sterilised.

Do not forget to elevate the limb.

Do not put on cobwebs, tobacco, shellac or salve.

Do not disturb blood clots.

Do not give whiskey or brandy.

Do not leave a wound uncovered after the bleeding has stopped.

For internal bleeding, apply ice-cold cloths to abdomen, lower the head slightly.

Wounds.

In injuries to the head, place the patient on his back, with head resting upon a cushion covered with a clean towel.

The arm, when injured, should be brought across in front of the chest and supported by a sling.

The lower limb should be supported on a cushion or blanket.

In chest wounds, the head and shoulders should be raised by one or more pillows until patient can breathe comfortably.

In wounds of abdomen, patient should lie down with knees drawn up and turned toward injured side; if wound be in front, place him on his back.

After covering a wound of any kind, do not uncover it; put on more bandages if it bleeds.

In bruises or sprains, apply hot water, as hot as can be borne; if an ankle is sprained or foot crushed, place it in a bucket of hot water, keeping the water hot by adding more hot water as required.

Fractures.

These may be simple or compound. A compound fracture is where there is an external wound communicating with the fracture. This may be caused by one end of the fractured bone penetrating through the skin, or by a spike or rifle ball or some other missile piercing the skin and tissues to the seat of fracture.

Place the patient in a comfortable position, supporting the injured member upon a cushion of some kind, which may be made with any soft material at hand. If possible to remove the clothing without causing much pain, it is best to do so. In simple fractures this is not absolutely necessary, as a splint can be applied over the clothing, using the latter for a pad.

In compound fractures, dress the wound with the contents of the first-aid packets, or with antiseptic gauze, before applying splint.

Do not attempt to set the bone; merely try to put the injured part in a position where it can be held securely, so as to prevent the fractured ends of the bone from rubbing together and causing pain.

Splints.

The chest can be used as a splint for the arm by binding the arm to the side with a roller bandage.

The uninjured leg may be used as a splint for the injured one.

A splint must be long enough to keep the joints above and below the injury at rest.

The splint should be a little wider than the thickness of the limb.

The splint should be padded with some soft material, such as sheet wadding, cotton, &c.

If two splints, one on each side of the limb, can be applied, all the better.

Material for splints is usually easy to obtain: cigar boxes, pasteboard, laths, shingles, barrel staves, broom handles, canes, shovels, umbrellas, desk rulers, fruit baskets, &c. Any of these may be used.

Place the splint on either side of the injured limb, have the splints well padded, and secure them to the limb with a roller bandage or a handkerchief; towels, suspenders, cord or straps may be used if the bandages are not at hand.

Someone should support the limb by slipping the hands gently under it, above and below the injury, while the others are applying the splints.

In fractures of the skull, place patient on his back with head and shoulders slightly raised, and keep quiet until surgeon arrives. If there is a scalp wound, place some antiseptic gauze over the wound.

In fractures of spine, keep patient flat on his back.

In fractures of collar bone, place pad under armpit, and bandage arm to side. Patient is best on his back.

In fracture of ribs, patient should be moved as little as possible. Keep head and chest elevated; let him lie on his back or on the uninjured side.

In fracture of thigh, apply a long splint made of board, to extend from below the foot to above the hip, first drawing the limb out to its full length, and bandaging the splint to the leg at the ankle, the knee and about the waist.

In fracture of knee-pan, place a pad in the hollow under the knee, and apply a splint to the back of the leg, keeping the leg straight.

In fracture of the leg below the knee, place the leg gently in a pillow, and bind the pillow to the leg. If no pillow is at hand, apply a board splint (taken from a fruit basket) to either side of leg and bandage, being careful not to bandage too tightly.

If a patient is to be carried some distance, bind the injured leg to the other limb, after applying splints.

In fracture of upper arm, place a pad in the armpit and draw the elbow to the side; bind the upper arm to the side of the chest and put the forearm in a sling.

In fracture of forearm, make a splint from a cigar box or a piece of wood long enough to extend from the fingers to near the elbow; place this on inner side of arm and another piece over the back of arm, and bandage.

In fracture of fingers, bind one finger to the other, after placing cardboard splint under the fractured member.

Burns.

Burns are of three degrees:

First—Simple reddening of the skin.

* Presented before the National Electric Light Association at its Twenty-Sixth Convention, held at Chicago, Ill., May 26th—28th, 1903.

Second—When blisters form.

Third—Charring of skin and ulceration.

Remove clothing carefully; cover burned surface quickly to exclude air; pour on oil. A mixture of equal parts of linseed oil and lime water forms the best and most convenient dressing for first aid, and should be kept on hand, in well-corked bottles in every shop where a workman is liable to be burned. Pour this freely on the surface, apply sterilised gauze and saturate that, then a layer of absorbant cotton, and soak that with the oil. When the burn covers a large surface, expose and dress a small area at a time. When a man's clothing is on fire, throw him down and roll him over to extinguish the flame, or wrap him in a blanket, or some woollen material, and press the burning points from the outside.

If no oil is at hand use a warm solution of baking soda in water; or use white of egg, or powdered starch, or toilet powder.

When a burn is very extensive, and patient is in a state of shock and grave danger, if there is a bath tub available, wrap him in a sheet, clothes and all, and lower him into the bath tub, which should be filled with tepid water. He may be kept there many hours with his head above the water. This is the best method to relieve pain and to prevent the danger from shock.

Burns from ammonia, lye, &c., should be bathed freely with water, then with vinegar and then with oil.

Burns from vitriol or other acids should be washed with water, then a solution of soda and lime water, mortar or chalk may be used; afterwards apply the oil.

A fragment of lime in the eye should be washed out with water, and the eye bathed with a weak solution of vinegar or lemon juice.

(*To be concluded.*)

SOUTH AFRICAN NOTES.

(From our Johannesburg Correspondent)

The Question of Telephone Trunk Lines.—The Cape Postmaster-General has reported on the cost of establishing telephone trunk lines between the more important towns of the colony. The matter has naturally cropped up many times during recent years, but the heavy estimated outlay, and the inadequate possible return thereon, have stood in the way of development. It seems that experiments were not long since made with long-distance telephones over disengaged telegraph wires with some success, and these experiments are being continued. A deputation from the Associated Chambers of Commerce waited upon the Postmaster-General in connection with a trunk service between Capetown, Kimberley, Johannesburg, and other important towns, when it was pointed out to them how large a capital expenditure would be involved in the construction of such lines. The cost of 1 mile of line of 35-ft. poles with one metallic circuit would be approximately £234, using copper wire of 200 lbs to the mile; whilst the cost of a trunk line to Johannesburg, *vid* Kimberley, would be about £225,800, or, if two circuits were erected, £257,650, the expenditure on poles and the chief labour and transport charges being practically the same in each case. If these circuits were to be worked to their fullest capacity, that is to say, ten calls an hour for eight hours a day for five and a half days a week per circuit, the cost per conversation would have to be 18*s.* for the one circuit-line, or 10*s.* 2*d.* for the two-circuit line, to cover the bare cost of maintenance and 4 per cent. on capital. Sir William Preece, the consulting engineer of the department, stated:—"In England we used 800 lbs. per mile for our main trunks, and I could not advise you to use less in your Johannesburg circuit of 1,200 miles length. Our speaking in England is far superior to that in the United States because they have cut the weight of copper wire. We find that we get between 70 and 75 talks a day between London and Glasgow, but this is limited by the peculiar hours of business in England. The bulk of work is between 10 a.m. and 12 noon, and between 3 p.m. and 4 p.m., and the whole day's work is less than four hours. Your hours of business may be different and better distributed. A talk lasts three minutes." The Postmaster-General says that with copper at £65 a ton in England, the cost of a line to Johannesburg with one circuit, using copper wire at 800 lbs. to the mile, would be increased by some £183,000, or with two circuits £366,000—that is to say, the total cost would be, approximately, £480,800 and £623,650 respectively—and that the rate per conversation would have to be proportionately increased to cover bare expenses, even if the line were worked at its full capacity. "It is possible that improved forms of apparatus may be introduced which will render it practicable to work over long distances with less costly lines, and my attention will constantly be given to this point, and I shall, further, not lose sight of the necessity for the colonial system keeping pace with progress elsewhere. In the meantime steps are being taken to bring into a thorough state of efficiency all local exchanges, in anticipation of the time when my officers can seriously take in hand the question of trunk connections. There is practically nothing to prevent the joining of towns nearly situated to one another, and some of these connections will be undertaken directly funds, material and the necessary trained employés are available."

Johannesburg Tramway Tenders.—Some discussion arose, it will be remembered, some months ago when the tender of the Brush Electrical Engineering Co. was before the Johannesburg Council for acceptance with certain foreign rails as part of the proposal. It is now understood that for some unexplained reason the Brush Co. have withdrawn their tender for materials for the construction of the permanent way of the new electric tramways in Johannesburg, and fresh tenders are being invited by the Town Council. "It is to be hoped," says a South African paper, "that British firms will profit by the discussion which took place when the original tenders were under consideration."

Harrismith Electric Lighting.—£19,000 is to be spent upon the electric lighting scheme, and a loan for this and certain other public works is now to be raised.

Electrical Cranes at Cape Town.—The *ss. Highland Corrie*, now in port, was the first vessel to be discharged at Cape Town by the new installation of electric cranes for working cargoes.

Pretoria Electric Lighting.—There is some grumbling about the electric lighting company's charge of 1*s.* 9*d.* per unit, it being called "freebooting rather than fair trading." There are those who declare that 7*d.* is sufficient, considering the price of coal. It is said that the temporary Commission at present administrating the affairs of the town is negotiating with the company for a reduction in the price of light, in return for which the company are permitted to provide power for and take over the administration of the municipal tramway system.

THE CRITICAL SPEED OF STEAM TURBINES.

In a letter to the *Street Railway Journal*, Herr Franz zur Nedden, of Berlin, refers to the great difficulties which the dynamo builder encounters when designing generators for use in connection with steam turbines. "These difficulties occur in arranging the generators for the peripheral speeds (1,500 r.p.m. to 3,000 r.p.m. and higher) which must be used in turbine construction for the sake of steam economy, and the necessity for direct-coupling the generator to the turbine shaft. The latter difficulty can hardly be avoided in large units, as all methods of speed reduction at high speeds are either unpractical at all or give too low an efficiency. On account of the necessity for high speeds of the rotating parts of the generator, centrifugal forces enter of a hitherto unknown magnitude. By using material of sufficient strength, however, a reasonable degree of safety may be obtained even at these high speeds, but there is another difficulty which must be overcome. It will seldom or never be possible to locate the centre of gravity of the rotating part in the centre of the shaft with mathematical exactness even with the most careful balancing. On account of this eccentricity of the revolving masses the resulting centrifugal force tends to bend the shaft. This bending increases with the speed of rotation and the eccentricity of the centre of gravity. In general this condition may be met by using a sufficiently strong shaft, and it does not become dangerous until the so-called "critical speed" is reached. As the flexure of the shaft increases with the centrifugal forces impressed upon it, and as the centrifugal force increases with the flexure, the bending tends to increase toward infinity, that is, until the shaft is broken.

"The following is a simple formula for finding the required number of revolutions (n) for breaking or infinite speed:—

$$n_\infty = 300 \sqrt{\frac{1}{d}},$$

in which d stands for the flexure of the shaft (expressed in cm.), caused by the weight of the rotor.

"To attain sufficient safety the dynamo constructor must only use one-half of the value given, that is, the actual speed must be $< 0{\cdot}5\, n_\infty$.

"From this the great importance will be seen of a method of quickly finding the critical speed value up to a certain degree. This method consists in the exact balancing of the rotors, and this latter is a point which is often not given enough care.

"The following requirements for balancing will be found satisfactory:—

"1. That the complete mounted rotor should be supported at the journal bearings and not at any other points when being balanced.

"2. That the rotor be supported at the bearings on cylindrical surfaces, which are cut with absolute exactness in order that there shall be no unevenness of surfaces which would introduce errors when testing.

"3. That the shaft be revolved between stationary points.

"4. That the rails for the support of the testing apparatus be placed throughout their entire length on foundations which are free from vibration.

"By following these requirements it is possible to reduce the radius of gyration to 1/300 mm. There is, however, a certain element of danger in the armatures of dynamos. Assuming that the apparatus is mounted correctly, yet owing to the great centrifugal force the shifting of a winding now and then can hardly be avoided. This, of course, will shift the centre of gravity, which shifting may easily have important effects on the armature. As a matter of fact, in spite of the most careful selection of the proper running speed in comparison with the critical speed, nearly all wire-wound armatures will give trouble. This is particularly true with direct-current machines, which, in addition to an armature, also have a commutator as a rotating element.

"The following methods are suggested for safely running high-speed turbo-generators:—

"1. Secure greatest possible difference between the actual running speed and the critical speed.

"2. Use alternators in preference to direct-current machines whenever possible, or better still—

"3. Use non-synchronous generators.

"This latter machine possesses the advantage of having an armature carrying absolutely no wire. In fact, this form permits the use of speeds up to 3,000 r.p.m. and 4,000 r.p.m. In the Moabite central station of the Berlin Electricity Works there has been running for several months a non-synchronous 1,800-H.P. turbo-generator giving wattless current, and it has given no trouble in the direction mentioned."

DEVICES AND FITTINGS FOR THE CURRENT ELECTRIC LIGHTING SEASON.

A Maxim Arc Lamp.

The Sir Hiram Maxim Electrical and Engineering Co., Ltd., manufacturers of the "Maxim" incandescent lamp, have brought out an enclosed arc lamp, which is the outcome of long experience both in the manufacture and actual working of arc lamps.

One of the chief features of the lamp is that the electrical connection to the top carbon holder, instead of depending on rubbing contacts—which, up till now, have been generally used in enclosed lamps, and are liable to cause bad connection and burning of contacts—consists of a piece of very flexible copper tape, which is secured to the carbon holder at one end and to the top of the lamp at the other, the slack being taken up by a small weight and pulley which moves up and down inside the tube. By this arrangement the connection is absolute and the freedom of the movement of the carbon and carbon holder is not interfered with.

The arc being controlled by solenoids, a definite potential is maintained across it, and, therefore, a definite candle-power and definite current consumption are obtained. When first switched on the lamps attain their maximum candle-power immediately, without any pumping whatever, and remain steadily burning, and giving the same light until switched off, whether indoors or out, and irrespective of climatic changes.

The lamps have self-contained line resistances and choking coils mounted immediately underneath the crown, and the heat generated passes out between the crown and cover instead of through the mechanism of the lamp. All lamps to burn in series of 280 volts and upwards, have also a self-contained automatic cut-out and substitutional resistance in order to protect the shunt solenoids of any lamp that may run short of carbon or cease working from any cause. A great saving is thus attained in erecting, as no separate cut-outs and resistances are necessary.

A special arrangement for the suspension of the solenoids and cores is attached to the alternating current lamps by which the noise, when burning, is reduced to practically nil.

The overall length of the lamps for ordinary running is 24 in., and that of the lamps containing a self-contained cut-out and substitutional resistance 27 in. A full description of the lamp, together with a good deal of other information respecting installing and so on, is given in Section A of the company's catalogue just published. The accompanying illustration shows the interior of a series D.C. lamp for working two in series on 200—230 volts.

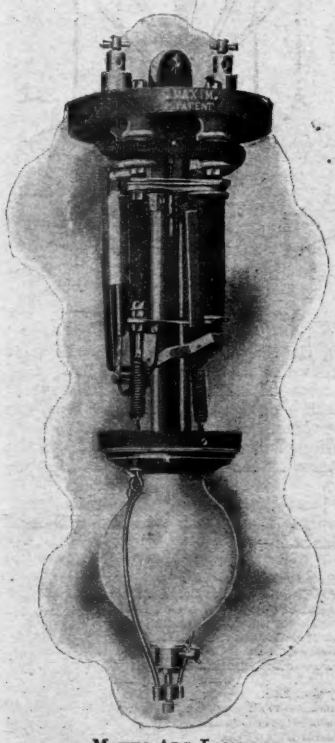
Brush Lamps and Fittings.

The enterprise of the Brush Electrical Engineering Co., Ltd., is once more evidenced in the preparations they have just made for meeting business in incandescent lamps and fittings. Their bulletin No. 4 is specially devoted to this department, and it is a production the excellence of whose arrangement and illustrations would be hard to beat in point of attractiveness. The Brush-Vienna lamps, which we read have been in use for over twenty years, are shown and priced, a code word being also given for each item; high and low voltage types, plain and fancy globes, traction lamps; various designs of fittings for churches, theatres, public buildings and residential premises, also for shop window, ship and factory lighting. For electric tramcar work there are various roof-lights, head-lights, &c., shown. A number of both interior and exterior views are given, showing large premises which have been installed with Brush lighting, and indicating the unobtrusive nature of the lamps and fittings. A line to Victoria Works, Belvedere Road, S.E., will be sufficient to bring one of these lists to anyone interested in the electrical installation business or the supply trade.

A Drury Lane Showroom.

Messrs. Evered & Co., Ltd., have a quite imposing showing of fittings of all kinds, including some exceptionally attractive specimens. Everything is of British manufacture, being turned out at the extensive factories at Smethwick and Birmingham, with the single exception of a beautifully-arranged show-case of French style bronze and other figure standards. In passing through the showrooms a practical instance of the necessity for the adoption of some form or other of protection in connection with certain branches of industry was pointed out.

Fig. 1.



Maxim Arc Lamp.

Fig. 2.

Fig. 3.

Evered Fittings.

Fig. 4.

Fig. 5.

Some exquisite specimens of original Evered designs of hammered copper work have been copied by foreign firms, who send their products to this country to sell at a lower price than the English manufacturer is prepared to place his upon the market. Any visitor to these showrooms, which cover a very wide area in Drury Lane, will find hundreds of new designs which have been produced by Messrs. Evered's artists and metal-workers in readiness for the season. The accompanying illustrations give a few examples of some of the attractive styles; but in a land of such plenty it is not the easiest task to know which have more genuine merit. The firm's book of designs consists of some 204 pages, and is divided off into three sections:—(1) Finished brass; (2) French and antique; (3) wrought-iron. In each of these sections are many varieties, more or less elaborate, to suit all tastes, of brackets, electroliers, pendant fittings, table and counter pillars, and so on. Fig. 1 shows a neat reflecting ceiling fitting, which is supplied in either polished brass, antique copper, or silver antique, for three or five lights; measuring across the metal band it is 16 in.; the opalescent glass dish is very effective in producing a softened illumination. Fig. 2 shows a double-arm bracket made in

polished brass and silver antique. An electrolier, which is made of a similar material and finish is represented by fig. 3; it can be made for three, four or five lights, and either with or without drop ends and opalescent glass. Fig. 4 is a specimen bracket from the wrought-iron section, while fig. 5 will, we believe, be regarded as a most pleasing table standard, showing how effectively the opalescent reflector or globe may be employed. Over-all this standard measures 19 in.

We may add that Messrs. Evered have just ready to place before the electrical trade a new fuse giving a 2½-in. break; it is known as their No. X 1,224, and particulars will be forthcoming very shortly.

FALK, STADELMANN & CO.

Messrs. Falk, Stadelmann & Co., Ltd., by reason of the extensive additions to their premises which were referred to in our columns some time ago, are able to set apart a very roomy ground floor department fronting on Farringdon Road, E.C., exclusively for the purpose of exhibiting their many varieties of electrical fittings and telephone instruments. Their gas and oil departments have likewise their own separate rooms. In a few weeks the electrical department will have its new season's catalogue completed ready for circulation, but a hurried tour of the showrooms revealed many new designs of all classes and finishes, for cord, chain and rod suspension. One feature of the latest work is a cheap range of wrought-iron shaded lights for dining rooms, billiard rooms, and so on; a further special line is shop-lighting fittings with wide-spreading arms; other designs of domestic fittings are in polished brass, &c., but hammered iron and copper devices of artistic merit are numerous. We understand that all of the electric fittings shown are of Birmingham manufacture. Those who are interested in the electrical contracting business will be courteously shown round by members of the staff if they call. Messrs. Falk, Stadelmann issued, a month or two ago, a new catalogue (No. 168) in which they illustrate a few of their lines of statuettes, wall decorations, &c., which are held in stock, including a range of portable standards and other pieces in the new art pewter, which harmonise with the style of decoration prevailing at the moment. Among their more attractive specialities for hall lighting, are lanterns with porcelain inlays. Fig. 1 shows a neat new design of bracket; figs. 2 and 3 represent the same fitting in both cases, but adapted to take the lamp or lamp and shade in different ways, according to the choice of the purchaser. The firm's telephonic apparatus is also well shown, including numerous intercommunication sets, the "Domestiphone" wall instrument, the "Logophone" drawing-room-kitchen communicator (a very cheap line, which is about to be placed upon the market), hand combination instruments whose receiver can be left off without exhausting the batteries, portable sets for military purposes, Kellog telephone instruments, and so forth.

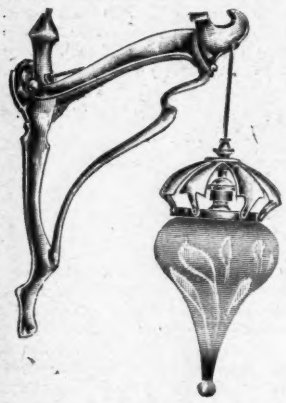


FIG. 1.

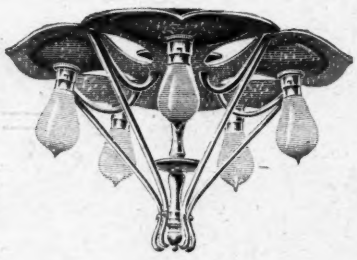


FIG. 2.

FIG. 3.

FALK, STADELMANN'S NEW FITTINGS.

SPECIAL FITTINGS WORK.

Messrs. Hart, Son & Peard, of Charing Cross Road, W.C., who are specialists in the domain of art metal working, although devoting themselves very largely to ecclesiastical and general decorative devices for theatres, country houses, for which special designs have to be conceived, also lay themselves out for electric lighting fittings for which high class work is required. A number of excellent specimens are on view in their showrooms. A good deal of their work up to the present, we believe, has consisted in the elaboration of complete designs of electrical fittings from start to finish. To put it briefly, a mansion is handed over to their care, and after investigating in a searching manner the requirements of the surroundings with which their work has to be brought into harmony, they see the thing through, the fittings being made at their manufactories at Grosvenor Works, Birmingham. Special designs and patterns are thus produced which possibly will never be used again in any other building. The firm does not, however, devote itself exclusively to this very special work, as consulting engineers and architects may see by visiting the showrooms.

(To be continued.)

Telephones on Trains.—The Highland Railway Co. announces that arrangements for telephonic communication between trains and stations on the line have been completed.

BUSINESS NOTES.

The Miller Signalling System.—On September 23rd, 24th and 25th, at the Hotel de Flandres, Brussels, the chairman of the British Miller Signal Syndicate, Ltd., Mr. Morrison, and Mr. Jackson, a director, together with Mr. Miller and their consulting engineer on the Continent, Mr. Douglas Wells, M.I.E.E., of Brussels, exhibited a full-sized model of the Miller system in the presence of leading railway officials. Mr. Weissenbruch, engineer-in-chief of the signal department of the Belgian State Railway, recently came to England to report for his Government on the Miller system at work at Woodhead on the Great Central Railway; owing to his visit it was thought advisable that the heads of the Belgian State Railways' Department should see a working model. It is understood that the New York Central Railway, after one year's trial, has accepted the Miller system.

Trade Announcements.—Messrs. Engelbert & Co. have removed their head offices from 44—47, Bishopsgate Street, to 119—125, Finsbury Pavement, E.C.

The Brockelbank Automatic Coupling Syndicate, of 35, Queen Victoria Street, E.C., has appointed Mr. Douglas Wells, M.I.E.E., of Brussels, to be its consulting engineer. Mr. Wells and Mr. Brockelbank have lately visited Berlin, Paris and Amsterdam, placing a model of the coupling before leading railway engineers.

Messrs. Wimshurst, Hollick & Co., Ltd., of 11—12, Clements Lane, E.C., announce that on and after October 9th all communications are to be addressed to them at South Fambridge, near Rochford, Essex, the head office and works of the company. The London office will be removed to 90, Cannon Street, E.C., from the same date, and the new telephone number will be "937 Bank."

The business hitherto carried on by Mr. F. H. Headley, of Truro, as an electrical engineer, contractor and manufacturer, will in future be carried on under the name of "Headley, Ltd."

Mr. P. B. Coulston, of Blackpool, has been appointed district manager at the Manchester office of the Brush Electrical Engineering Co., of Loughborough.

The change of address of the following companies from Surrey House, Victoria Embankment, W.C., to Donington House, Norfolk Street, Strand, W.C., is announced:—

Banbury and District Electric Supply Co., Ltd.
County of Durham Electrical Power Distribution Co., Ltd.
Sheerness and District Electric Power and Traction Co., Ltd.
County of Northampton Electric Power and Traction Co., Ltd.
County of Surrey Electrical Power Distribution Co., Ltd.
Lewes and District Electric Supply Co., Ltd.
North Metropolitan Electrical Power Distribution Co., Ltd.
Penarth Electric Lighting Co., Ltd.
Thames Valley Electric Supply Co., Ltd.
Weston-super-Mare and District Electric Supply Co., Ltd.
County of Durham Electric Power Supply Co., Ltd.
North Metropolitan Electric Power Supply Co.

Football.—A match between Veritys' Athletic Club and General Electric Co., was played on Saturday last on Veritys' ground at Manor Farm, Highgate, and resulted in a victory for the G.E.C. team by 5 goals to 1. The match was the opening one of the newly-formed Veritys' Athletic Club. From the start it was evident that the better combination enjoyed by the General team gave them an immense advantage, in fact, to this was due their very creditable victory. It was pleasing to note that the greatest friendship prevailed throughout the game, and no doubt, as time goes on, and Veritys settle into their form, we shall see a most interesting game in the return match on February 6th next.

Books Received.—"Etat Actuel du Labourage Electrique," by Emile Guarini. Paris: *Le Génie Civil*, 1903.

"McGauran and Jenvey's Differential Diplex System of Telegraphy," by H. W. Jenvey. Melbourne: Telegraph Post Office, G.P.O., 1903.

"Annual Report of the Glasgow and West of Scotland Technical College for 1903." Glasgow: The G. & W. S. T. College.

"Royal Technical Institute, Salford, Calendar for the Eighth Session, 1903-4."

Electrical Wares Exported.

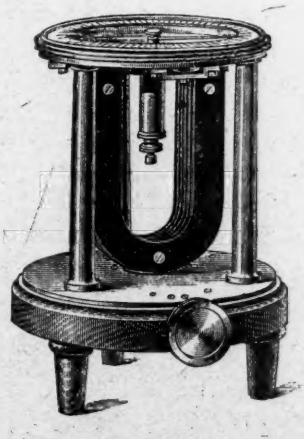
Week ending Oct. 7th, 1902.		Week ending Oct. 6th, 1903.	
Adelaide	Value £122	Adelaide	Value £34
Alexandria	660	Amsterdam	5
Auckland	96	Antwerp. Elec. fuse	330
Beira. Teleg. mat.	109	Bombay	121
Bergen. Teleg. cable	968	Brisbane. Teleg. mat.	33
Bombay	84	„ Telesph. cable ..	586
Calcutta	67	Buenos Ayres	126
„ Teleg. wire	58	„ Teleg. cable ..	200
Cape Town	883	Calcutta	496
„ Teleg. cable ..	3,039	„ Teleg. mat.	500
Christiania. Teleg. wire ..	26	Callao. Teleg. cable	5,873
Colombo	213	Cape Town	364
Copenhagen. Teleg. wire ..	120	Colombo	20
Durban	355	Delagoa Bay	1,563
East London	751	„ Teleg. mat. ..	395
Flushing	69	Durban	3,639
Hamburg. Teleg. mat.	300	„ Teleg. mat.	693
Hong Kong	41	Gibraltar	20
Lisbon	100	„ Teleg. mat. ..	114
Melbourne	72	Hamburg. Teleg. mat. ..	320
Odessa. Teleg. apparatus ..	36	Hong Kong	27
Penang. Teleg. cable	242	Lyttleton	346
Perth	42	Madras	182
Rio de Janeiro	93	Malta	29
San Francisco. Teleg. cable	360,000	Melbourne	71
Shanghai	176	„ Teleg. mat. ..	2,040
Singapore	64	Monte Video	82
Sydney	219	Nagasaki	56
Wellington	73	Penang	18
		Perth	412
		Port Elizabeth	117
		Rio Janeiro	206
		„ Teleg. mat. ..	235
		Rotterdam. Teleg. mat. ..	22
		St. Petersburg	600
		„ Teleg. cable ..	48
		Santos	20
		Shanghai	1,277
		Singapore	61
		„ Teleg. mat.	57
		Stockholm. Teleg. wire ..	73
		Sydney	284
		„ Cable	2,080
		„ Teleg. mat.	964
		Trinidad	18
		Valparaiso	215
		Vera Cruz	89
		„ Elec. cable	2,364
		Wellington	3,429
		„ Teleg. mat. ..	138
		Winnipeg	40
Total ..	£368,888	Total ..	£30,967

Foreign Goods Transhipped.

Colombo. Elec. light mat.	Value £16	East London. Elec. lamps	Value £55
Durban. Elec. goods	30	Naples. Elec. goods	15
Gothenburg. Elec. apparatus. .	41	Santos. Elec. mat.	36
Sydney. Elec. goods	60	Wellington. Teleph. mat. ..	1,358
„ Elec. lamps	65		
Wellington. Elec. goods ..	38		
Total ..	£250	Total ..	£1,464

Blondel-Carpentier Hysteresimeter.—The new instrument devised by MM. Blondel and Carpentier for the measurement of hysteresis is an apparatus which is intended for industrial use, and which requires no special skill in manipulation. It enables the relative values of iron samples to be estimated within about 5 per cent.

The principal part is a permanent magnet of U-shape, the legs of which are vertically disposed, and which can be continuously rotated upon its axis. This magnet rests upon a collar, and is

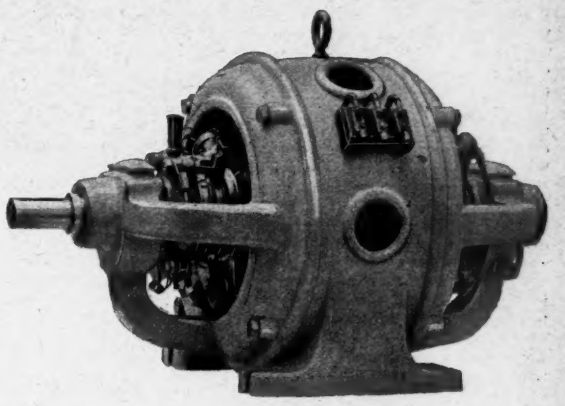


guided at the top by three rollers bearing against the periphery of a ring securely fixed to the magnet. The pivot is surmounted by a small disc to which is applied a copper roller, driven by a crank which is rotated by hand.

The sample to be tested is placed upon a brass support which fits on a vertical spindle; the latter rests at its lower end in a collar, while its upper end is guided in a bush fixed in the middle of the glass cover of the instrument. The sample thus mounted is free to rotate with the spindle, but the whole is controlled by a helicoidal spring.

When the magnet rotates, the induction undergone by the sample is displaced in its substance and hysteresis is manifested by an effect similar to that of friction. Hence the sample is rotated, twisting the spring until equilibrium is attained between the opposing couples. The deflecting couple is independent of the speed of rotation. The energy absorbed by hysteresis per revolution is therefore constant, and is measured by the angle read upon the instrument, multiplied by a constant.

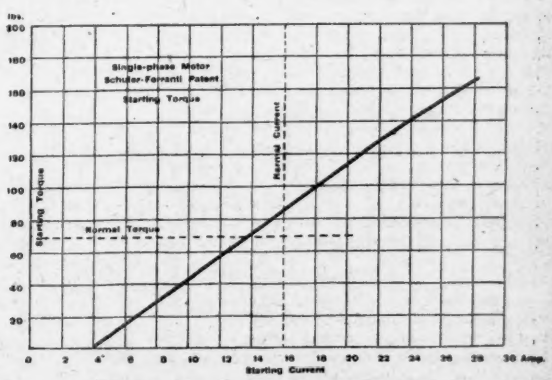
Single-phase A.C. Motor.—We give herewith an illustration of a new type of single-phase motor, which is being made by Messrs. Ferranti, Ltd., of Hollinwood, under the Schüler-Ferranti patent. The motor is of the semi-enclosed type, and is self-starting; the stator is of the usual type, with former-wound coils, in a circular cast-iron frame. The rotor differs from the ordinary type in that it is provided with a commutator at one end and slip rings at the other; the brushes bearing on the commutator are short-circuited by means of a copper ring, while those on the slip



Schuler-Ferranti Single-Phase Motor.

rings are connected with a starting resistance. As soon as the current is switched on the motor starts running; the starting resistance is then gradually cut out, until the motor is running at full speed.

The motor runs without sparking at the commutator—which, moreover, under normal running conditions, carries no current, and the direction of rotation can be reversed by means of a change-over switch. It is stated that the motor has a high efficiency and power factor, and can be built for low and moderate speeds; but its special feature is, of course, its ability to start with a low current. It is claimed that the motor will run up to speed on no load with only one-third of the full-load current; that it will start against the full load, giving 1½ times full-load torque, without exceeding



Starting Torque and Current of Motor.

the full-load current; and that it can be arranged to give double the full-load torque at starting with only 1½ times the normal full-load current. It is also guaranteed to withstand an overload of 50 per cent. for five minutes. The motor is therefore suitable for driving lifts, cranes, &c., which require a large effort at starting, such as cannot be obtained from the ordinary single-phase motor.

Catalogues and Lists.—Milner's patent universal speed indicator which is just being put upon the market by the General Electric Co. is described in a new leaflet just issued. It is claimed to be simple in design, and reliable in its method of working. Its great feature, however, is the fact that it can be used in any position, and that it will register equally accurately in either direction of running, and the dial can be turned in any position, both of these advantages being obtained without any disconnection or readjustment. It is based on pneumatic principles, and has no wearing parts, the needle and balancing parts being set in jewels. There is no mechanical connection between the driving and indicating portion, so that a perfectly steady needle is obtained.

When the indicator is once adjusted, it will remain constant; it can be calibrated to suit any speed, and is quite free from magnetic influence. It has been tested and used already by leading engineers, who are highly satisfied with its working. Owing to its reliability and sensitiveness and the ease with which it can be fixed in any position, it can be used wherever it is necessary to know the number of revolutions of any machinery.

A pamphlet has been issued by the British Insulated and Helsby Cables, Ltd., describing, with the aid of photographic and line illustrations, the Harison patent automatic signal system, which is adaptable for tramways, light railways, and tube railways The company are the sole makers of the apparatus, which is already used at Portsmouth, Batley, Wallasey, and other places. A description appeared in the Electrical Review for June 13th, 1902.

The B.T.H. Co., of Rugby, has issued two new pamphlets, prepared in its accustomed style; No. 151 describing the Thomson polyphase recording wattmeters, and No. 152, detailing several styles of the G.E. type tramway motors.

Several leaflets have just been issued by Messrs. Le Carbone of Water Lane, Great Tower Street, E.C., describing some different kinds of new cells and parts thereof. One is known as the "Carbi" sack-type cell (Busson patent), with special depolariser; it is said to be particularly well adapted for telegraphy, telephony, bells, signals, and all intermittent work. It is alleged that the size made for the No. 2 ordinary porous pot glass jar will outlast three of the ordinary porous pots, with greatly lessened zinc consumption. The special depolariser of the Carbi cell ensures that no crystals shall form on the zinc; the sacks fit the three regular sizes of Leclanché-type glass jars. Another list details the Carbi ignition cell for stationary gas and petroleum motor work. The positive element is zinc, the excitant is an ordinary sal ammoniac solution, and the negative element is carbon enclosed in a canvas bag. In the bag around the carbon is packed a special depolariser. The sack is provided with a cover, which projects beyond the rim of the containing glass jar, and effectually prevents evaporation of the electrolyte. A third circular shows the Carbi sack cell of the hermetically sealed type, with octagonal and square glass jars for testing electro-medical, ignition and alarm work. Porous carbon cells, Star agglomerate blocks, corbon-headed plates, dynamo and motor brushes are dealt with in other lists.

As already stated in our issue of 18th inst., the fuse business of Messrs. W. Macdonald & Co. has been converted into a limited liability company under the title of the British Electric Calibrated Fuse Co., Ltd. Mr. W. Macdonald and Mr. G. E. Heyl-Dia are permanent co-directors. The company has now prepared and issued a catalogue of electrical fuses embracing numerous types, and the aim has been to turn out every type of fuse to operate faithfully to its certified rating. A special fuse wire which has been termed "Pyrotin" has been introduced, whose special properties are claimed to be a high-metallic lustre, and that it is clean, smooth, and free from scaling or cracking, which, in the case of ordinary tin wire, gives it an uncertain fusing point. The contents of the list are Pyrotin and pyro-copper tested fuse wire, open-type multiple-wire fuse links, calibrated fuse strip, enclosed fuses, a fuse repair kit, &c.

Messrs Johnson & Phillips, of Old Charlton, have just issued a new catalogue, No. J.B., in which they particularise, with a number of detailed drawings and photographs, their various designs of junction boxes, feeder boxes, switch pillars, and cable accessories of which they have accumulated a large number of designs and patterns during their very lengthy experience in this class of work.

The Langdon-Davies Electric Motor Co., Ltd., of 101, Southwark Street, S.E., place before the trade and power users generally full particulars of their motors and the uses to which they may be put, in a pamphlet and some loose sheets which have just come from the press. A small folding card gives a table of speeds, voltages, sizes and prices of direct-current protected motors, ranging from ⅛ B H P. to 13 B H P; another card similarly arranges the prices and speeds of standard pattern single-phase alternate-current motors of from ¼ to 35 B H P; and a third gives like details of two-phase motors (50 ~) of standard and slow-speed types. In the 40-pp pamphlet the Langdon-Davies motor, its construction, uses, advantages over the small gas engine, performances under test, and so forth are gone into somewhat fully. An imposing list of the public supply circuits on which the motors are at work, and many pictures showing the manner of their application to driving machinery are included in the catalogue. Some data which may be useful in deciding the user of other forms of energy to change over to electricity consists of a list of examples showing the cost per week of running small machines by Langdon-Davies motors. The costs have been calculated on the basis of a working week of 54 hours, reckoning, generally speaking, the charge per unit as 2d.

Messrs. Holden & Brooke Ltd., whose supply of new lists of late may be regarded as evidence of increased enterprise and push, which it is gratifying to note with any firm at any time, have brought out a list, No. 58, placing before the steam-user "What we Make," in the direction of steam appliances. Their specialities, such as injectors, ejectors, grease separators, feed, heating and other kindred apparatus, hardly need further enumeration, but a copy of this list will be sent to anyone who chooses to ask for it.

The Permiol Manufacturing Co., Ltd., of Croft Street works, Pendleton, Manchester, are introducing a new paint for outside work. It is called "Permiol," and does not contain any lead or zinc or other poison, such as is generally embodied in other paints; being 50 per cent. lighter, volume for volume, any given weight or quantity will cover a much greater surface than ordinary paint. It is claimed to possess special protective qualities against the more actively disintegrating agents, for all outdoor metal and woodwork and exposed metal structures, including trolley poles, &c.

Dissolutions and Liquidations.—On the petition of the American Electrical Novelty and Manufacturing Co., Ltd., the County Court of Lancashire, on September 18th, ordered that the voluntary winding-up of the Patent Exploitation, Ltd, be continued, subject to the supervision of the Court. Mr. W. H. Beeston retired from the office of liquidator, and Mr. J. M Wade, of 5, Fenwick Street, Liverpool, was appointed in his stead.

Messrs. W. A. Mathew and H. R. Wilding (W. A. Mathew & Co., motor, electrical and general engineers, High Street, Beckenham) have dissolved partnership. Mr. Mathew attends to debts.

The Renewable Electric Lamp Co., Ltd., of Brunswick Works, Brunswick Place, City Road, N, is to be wound up voluntarily. Mr. D. L. Chalmers, of Vron House, Llangollen, was appointed liquidator on September 22nd.

Tramway Contracts.—Messrs. Edgar Allen & Co., Ltd., of Sheffield, have secured, through the contractor, Mr. George Law, of Kidderminster, the contract for the supply of the whole of the cast-steel points and crossings and special work required in the reconstruction of the Gloucester Corporation tramways. They have also secured, through the contractors, Messrs. William Griffiths and Co., Ltd., the contract for points and crossings and special work for the Worcester Corporation Tramways, and from the British Electric Traction Co., Ltd., the contract for points and crossings and special work for the reconstruction of the Birmingham and Midland Tramways All the Worcester and Birmingham and Midland points are fitted with Allen's Imperial manganese steel tongues.

For Sale.—The business of the Dudley Art Metal Co., Ltd (in liquidation), of Dudley, is being offered for sale as a going concern.

Messrs. Wheatley Kirk, Price & Co. will shortly offer for sale by auction the modern machine tools, stores and effects of the Castle Works, Northfleet.

American Electrical Exports.—The value of the electrical machinery exported from the United States during the seven months ending with July last is returned at only £627,993, as compared with £667,544 in the corresponding period of last year. On the other hand, the exports of electrical apparatus increased from £425,177 in the first seven months of 1902 to £477,093 in the seven months ending with July last.

ELECTRIC LIGHT AND POWER NOTES.

Accrington.—The T.C. has received from the L.G.B. sanction for a loan of £550 for the purchase of additional machinery for the electricity works.

Ashford (Kent).—The U.D.C. has received notices from Messrs. Pressland & Fippard, and the Hiram Maxim Electric and Engineering Co., Ltd., to the effect that they intend to apply for prov. orders for supplying electricity in the town. The Council is negotiating with Messrs. Foote & Milne, and Messrs. Pressland and Fippard as to leasing the Council's order.

Aston.—The Electric Power and Lighting Station in Chester Street was formally opened last week. The engine house is 45 ft. wide, and at present 80 ft. long, but with a view to extensions the end is a temporary iron one. There are three compound engines directly coupled to dynamos. Two of the engines are of 800 H.P. each, while the third is of 400 H.P., making a total of 2,000 H.P. The dynamos are of 1,250 KW. The power house is so arranged that extensions may be made with a minimum of inconvenience. The boiler house contains three pairs of tubular boilers. The Council have also sunk an artesian well, 300 ft. deep, for the provision of their own water supply. From this the water is raised by electrically-driven pumps to a storage tank of 20,000 gallons capacity, which is on the roof of the building.

Austria.—The Siemens-Schuckert Co. has secured a contract for a large electric lighting and power transmission plant at the State Lime Works at Rudersdorf.

Bolton.—Horwich has asked the T.C. to extend its E.L. mains to the town, and the matter is under consideration.

Brazil.—H.M. Consul-General at Rio de Janeiro, in describing a short journey into the State of Minas Geraes, calls attention to a possible opportunity of establishing small electric plants in different localities for the production of ice, for the making of butter, and for electric light and power for small machinery; also to the possibility of developing a demand for a light and suitable plough.

Bridgend.—Some interesting points have arisen as to the construction of certain clauses in the agreement between the Bridgend Council and the South Wales Electrical Power Distribution Co. The agreement provides that the Council shall pay for electrical energy, 2½d. per unit, plus ½d. for transformation, for 50,000 units, and that the price per unit shall decrease according to a scale agreed upon, as the total amount of electricity taken increases. There is also a clause that when any similar body in the district obtains energy from the company at a lower rate the Council rate shall be similarly reduced. Some months ago the company voluntarily reduced the charge to 1½d. per unit, plus ½d. for transformation, upon which terms it had recently agreed to supply the asylums. Within the urban district the company had no right to supply energy for lighting purposes without the consent of the Council. The company, therefore, represented to the Council that it would lose several large power customers, whom it had in view,

unless it were allowed to supply them with electricity for lighting purposes as well as power. The Council gave consent, but it was conditional upon its being allowed the ¼d. which the company charged for transforming the town supply. The general manager of the company contended that the Council should be satisfied with the reduction already granted. Councillor Thomas contended that the Council was entitled to the former reduction on the ground that it was a similar body to the Asylums Committee, and that the company would have no power to revert to the higher rate if the allowance of ¼d. was insisted upon. It was resolved to demand the allowance. The reply of the company was an emphatic refusal, and the Council has now decided to prohibit it from supplying light to any firms within its district. The next move of the company is being awaited with considerable interest.

Brighton.—The T.C. has applied to the Steyning East, Steyning West and Newhaven R.D.C.'s for consent to the supply by the Corporation of electricity to consumers in parishes in the Council's areas.

Brynmawr.—The U.D.C. has decided to apply for a provisional order for supplying the town with electric light.

Carnarvon.—At the meeting of the T.C. a communication was submitted from Mr. A. Harper, engineer to the North Wales Power and Traction Co., Ltd., offering to provide the Corporation with a continuous electrical supply. The company were prepared to erect a distributing station within the borough, and to supply energy at a maximum rate of 3d. per B.T.U. for both power and lighting, with suitable discount for power consumers. The company would convey its energy at its own expense to this station, and deliver in bulk at a voltage suitable for both lighting and power, the distribution being undertaken by, and being the property of, the town. As an alternative proposal the company was prepared to undertake the distribution itself, and to deliver to the consumers' terminals at a maximum rate of 4d. per B.T.U. for lighting, and 2d. per B.T.U. for power, in which case the order and the whole undertaking would be the property of the company. The company was also prepared to give the necessary guarantees and sureties for the completion of the work, and to reserve to the Corporation a call for any power which might be required for tramway purposes at a special rate. It was decided to obtain expert advice on the offer.

Coventry.—The T.C. has decided to allow consumers an alternative uniform rate of 4½d. per unit, and that consumers of energy for motive power who take more than 2,500 units per quarter be charged 1½d. per unit up to, and 1d. per unit beyond that quantity. The electric light mains are to be extended at a cost of £970

Dublin.—A L.G.B. inquiry has been held into the application of the City Council for sanction to borrow £48,000 in connection with the central station, and £28,500 for electrical works in the Clontarf area.

Dundee.—The Finance Committee of the T.C. has recommended the Council to apply to the Secretary of Scotland for additional borrowing powers to the extent of £74,000.

Epsom. — The U.D.C. is applying to the L.G.B. for sanction to borrow £5,930 for electricity extensions during the next three years. It is explained that the loan will only be taken up as sums for mains, meters, &c., are required from time to time.

France.—The Municipal Council of Lyons has prepared a plan for the electric lighting of the city. It is proposed to instal 159 arc lamps in the principal thoroughfares.

The town of Besançon (Doubs) is prepared to receive applications for the establishment and working of an electric power installation at Besançon and Mouthier, the energy to be obtained from the falls of the River Loue.

Friern Barnet.—The Board of Trade has consented to postpone the consideration of revoking the prov. order granted to the U.D.C. until August 9th, 1904.

Finchley.—In the estimates adopted by the U.D.C. for the half-year to end March 31st next, the expenditure on the electricity undertaking is put down at £1,204 9s. 11d., and the revenue £965.

Hornsey.—5,000 copies of a pamphlet giving the terms of electric supply for lighting and power are being printed for the B.C. for circulation in the district.

Gateshead-on-Tyne.—The North-Eastern Railway Co. has now decided to substitute electricity for steam power for the driving of the whole of the machinery contained in the company's locomotive works at Gateshead-on-Tyne. The contract, which has just been placed, is one of the largest of the kind that has been made during recent years. Power will be supplied by the Tyneside Electrical Power Co. from their Neptune Bank station.

Glasgow.—The T.C. has remitted back to the Committee the latter's report, on the hiring out of motors, for further information.

Greenock.—A discussion took place in the Parish Council on a proposal that Smithston Asylum and Poorhouse should be lighted with electricity. The sub-committee agreed to ask the Corporation to forego the guarantee of a minimum payment of £300 per annum for 10 years on the understanding that the Parish Council would not generate electricity at Smithston for lighting purposes, nor receive it from any other source during the same period. It was agreed by the Council to hold the matter over for a month.

Inverness.—At last a definite decision has been arrived at in connection with the proposal to introduce the electric light into the burgh. The offer of Messrs. Edmundson's Electricity Corporation has been accepted to work the undertaking under a lease of the prov. order held by the town. It is anticipated that the proposed works will involve an expenditure of about £25,000.

Italy.—La Societa Italiana di Condotto d'Acqua di Milano has applied for a concession to put down plant to utilise the water power of the River Ticino at Besale in the generation of electrical energy and to distribute the same for lighting and power purposes at Milan and Pavia.

Lancaster.—The T.C. has decided to dispose of the old machinery at the E.L. works, with the exception of the balancer and overhead crane, to Mr. T. W. Ward, of Sheffield, for £1,150. The original value was between £5,000 and £6,000.

Leeds.—A L.G.B. inquiry has been held respecting the Corporation's application for sanction to borrow £220,000 for electric lighting purposes. The town clerk stated that extensions of mains and motors would necessitate an expenditure of £70,000 per annum during the next three years.

London.—Bethnal Green.—At the B.C. meeting it was decided to apply to the L.C.C. for sanction to borrow £15,750 for a site for an electricity generating station.

Wandsworth.—The B.C. has decided to ask the County of London and Brush Provincial Electric Lighting Co. to reduce their charges for lighting to a flat rate of 4½d. per unit.

Woolwich.—The town clerk reported to the B.C. at the last meeting, that the Act giving Foot's Cray power to purchase energy in bulk from Woolwich, and permitting Woolwich to arrange with private consumers for assisted wiring, had received the Royal Assent. When the Committee was able to estimate the number of persons willing to avail themselves of the special terms offered, a loan would be applied for.

Bermondsey.—The B.C. has resolved to reduce the charges for power to the following scale:—2d. per unit up to 10,000 units per annum, 1½d. per unit between 10,000 and 20,000 units, 1½d. per unit between 20,000 and 30,000 units, for over 30,000 units a special rate. The chairman of the Electricity Committee said the previous reduction had induced a large number of people to adopt the supply. Large consumers, however, still found gas the cheaper power, and it was to meet this competition that the charges had now been further revised.

Westminster.—The Works Committee of the Westminster City Council has approved an agreement with the Charing Cross and Strand Electricity Supply Corporation for the extension of electric lighting in the Strand from the Hotel Cecil to Temple Bar.

Poplar.—The electrical engineer to the B.C. reported having received applications for energy representing a total of 95 kw. As, however, he warned the Committee that a serious risk would be run during the winter in coupling up new consumers without extension of the existing plant, it was resolved that under present circumstances applications for premises not in the Isle of Dogs, should only be accepted, and then subject to the condition that energy shall not be taken between 4 p.m. and 10 a.m. during the three winter months.

Islington.—At a recent B.C. meeting, four deputations from trades unions were received, and protested against the recent reduction of wages at the electric lighting station and the withdrawal of the extra pay for overtime. It was contended that it was impossible for private employers who adhered to the trade union rate of pay to compete with the Council, who paid less. Several Councillors contended, in the discussion that followed, that the regulations for the electric lighting workmen were strictly in accordance with the trade union scale. In the result, the whole matter was referred to a special committee.

Hammersmith.—The borough surveyor and the electrical engineer have, in accordance with a resolution of the B.C., drawn up a joint report upon the proposed establishment of a dust destructor. Having examined the annual returns of six London municipal electric light stations, three having the assistance of destructors and three with coal only, the following comparison showing the value of a dust destructor were obtained:—Capital expenditure per kilowatt of non-destructor stations, £80; ditto, destructor stations, £118. The working costs of non-destructor stations is 0·2d. per unit higher than the destructor stations, which upon 5,774,644 units (their total output) represents £4,895. The extra cost of the capital involved to effect that saving is apparently, at 5 per cent., £7,395, showing a net loss of £2,500 per annum as the result of combining dust destructors and electric light stations. It was true that in the adjoining borough of Fulham the resident engineer reports that the value of the fuel saved was £2,260 per annum. This, however, would be turned into a loss of about £200 if a proper amount was set aside for the depreciation of the special plant. Finally, the Hammersmith engineers agree that barging is more economical at present, and that the refuse has not sufficient calorific value to justify the combination of a destructor with the electricity works. However, in view of the probability of the cost of cremation decreasing in the future, while the expense of barging is likely to increase, they recommend the Council to endeavour to acquire a suitable site for a destructor.

Marylebone.—The L.G.B. has informed the L.C.C. that it has no alternative but to uphold the C.C.'s decision, not to sanction

the borrowing of the amount by the B.C. necessary to purchase the Marylebone property of the Metropolitan Electric Supply Co. The B.C. has already taken the necessary steps for promoting a Bill in the ensuing session of Parliament to obtain the requisite borrowing powers.

Longton.—The T.C. has declined to give consumers an alternative of a flat rate on the ground that such an alternative would only benefit short-hour consumers at the cost of long-hour consumers. The prices charged are:—8d. for the first hour per day, 5d. for two hours, 4d. for three hours, 3½d. for four hours, and 3d. for six hours.

Macclesfield.—The T.C. has decided, by a majority of two, to refer the report recommending the adoption of Messrs. Crompton's scheme for electric lighting, back to the Committee.

Reigate.—The T.C. has decided to extend the E.L. mains, at a cost of £426.

Rotherham.—A loan of £14,670 for E.L. purposes has been applied for by the T.C., and a clause for the hiring of motors is to be included in the Bill to be promoted in the next session of Parliament.

St. Albans.—The T.C. has applied to the B. of T. for sanction to an agreement with the North Metropolitan Electric Power Co. for the supply of electricity to the town.

Spain.—Application has been made for a concession to supply energy for electric lighting purposes from the central station at Jrguela to the little towns of Almendros, Villarubbio and Saelices.

Sunbury.—The Twickenham and Teddington Electric Supply Co. has offered to supply electricity to the U.D.C. for public lighting at a price not exceeding 2½d. per unit, and to private consumers at 7d. for the first hour per day, and 3d. afterwards.

ELECTRIC TRACTION NOTES.

Birkenshaw.—A new branch line to Birkenshaw, in connection with the Bradford City tramways, has been completed. It leaves the main line from Bradford to Tong, at the junction of the Drighlington and Birkenshaw roads. The terminus of the B.E.T. Co.'s line to Cleckheaton is but a few yards distant from the Birkenshaw end of the new extension from Bradford, but as the gauges of the two systems differ there can be no interchange of traffic.

Birmingham.—Mr. Baker has taken up his duties as tramway manager. He will first of all superintend the electrification of the Aston route, which may be completed by Christmas.

Blaydon-on-Tyne.—At the last meeting of the U.D.C. it was stated that the Newcastle-on-Tyne Corporation had purchased the Suspension Bridge at Scotswood, and it was understood that it was the intention of the Corporation to run a service of trams to Blaydon.

Bury and Heywood.—The tramway agreement which the Bury Corporation had hoped to arrive at with the Heywood Corporation is at an end, Bury refusing to accept Heywood's terms. The difference is mainly on two points, namely, as to the number of years within which they should liquidate their obligations to the existing tramway company, and as to the method of paving the track. Alderman Sykes told the Bury Town Council at a meeting last week that he hoped the private company, which threatened legal proceedings, would "hurry up with their writs." The Bury Tramway Committee were "itching to receive them."

Eastbourne.—The T.C. has informed the B.E.T. Co. that as a system of motor omnibuses has been inaugurated, there is no necessity for electric trams, and that if they should be required the Corporation would provide its own system.

Eccles.—By the construction of a new bridge over the the Bridgewater Canal, at Monton, shortly to be undertaken, the Eccles tramways can be continued from Monton Green so as to join the South Lancashire system in Worsley Road. This work is to be undertaken as soon as practicable. It is also proposed to connect these lines with those at Peel Green, so as to give a circular route to Eccles.

France.—A project is on foot under the auspices of the general council of the department of the Vosges to construct a system of electric tramways at Epinal.

Glasgow.—The sub-committee of the T.C. are considering the question of fitting top coverings to the cars.

The T.C. is not to apply to Parliament in the next session for powers to make any further extensions.

Huddersfield.—The merit system, by which new employés would have received stripes and a gradually increasing rate of wages, has been abandoned on account of objections raised by the men, who prefer that the maximum rate of wages should be paid at once instead of a smaller amount to begin with, and a larger amount when the highest number of stripes have been obtained.

The offices at the steam tram depôt in Great Northern Street, which has fallen into disuse, have been placed at the disposal of the employés, who have established a reading room and gymnasium, providing their own appliances.

A deputation visited Huddersfield on Monday from the Glasgow Tramways Committee, and they inspected the car-top covers.

Hyde.—It has been decided by the Stalybridge, Hyde, Mossley and Dukinfield Joint Electricity and Tramway Board to extend the line of tramways from the Church at Millbrook, through Heyheads and Carrbrook, to the junction of Egmont Street, in Mossley. The General Purposes Committee of the Board say they cannot see their way to extend the lines through Mottram from the Stalybridge boundary to the Hyde boundary. Arrangements have been made for temporary running powers between Ashton and Stalybridge. An additional length of tramlines (200 yards) is to be laid from Stockport Road, Mossley, past Carrhill Road.

Italy.—From statistics which the Minister of Public Works at Rome has just issued, it appears that there are 3,306 km. of tramways in Italy, exploited by 73 companies. A number of these companies were founded by foreign capitalists. The first electric tramway established between Florence and Fiesole dates from 1890. Numerous others have since been constructed, and in 1900 it was estimated that the electric lines covered a distance of 353 km., whilst the steam extended over 2,952 km. These tramways give employment to 11,000 people, and their rolling stock is composed of 2,889 cars for conveying merchandise, 1,728 travelling cars, 577 steam locomotives and 1,043 electric automotors.

Leeds.—A loan of £125,890 for tramway purposes has been applied for by the T.C.

Liverpool — Southport Electric Railway. — The electrification of the Liverpool and Southport line of the Lancashire and Yorkshire Railway Co. will shortly be completed. The laying of the conduits and rails, and the erection of the generating stations was begun several months ago. Steady progress has been made with these works. The principal generating station is at Altcar. Sixteen large boilers are already housed there. It now remains to equip the generating stations and sub-stations with the machinery for which they are waiting. Time is not being lost in regard to the work on the line, and all will be ready, it is hoped, for a trial to be made in December. If all goes well the new electric service will be inaugurated in January. Everything points to the possibility of this being accomplished. There is comparatively little goods traffic on the Liverpool and Southport line, but the passenger traffic is considerable.

London.—Greenwich.—The B.C., while not objecting to the L.C.C.'s proposed tramways from Greenwich to Catford, and from Deptford across Blackheath to the Herbert Hospital, has declined to make any contribution to the cost of the necessary street widenings.

Manchester.—The Municipal Tramways Committee are engaged in completing some important cross and circular routes supplementary to the main tramway system of the city. The lines in the district which lies between Oldham Road and Ashton New Road, a very densely populated one, are already laid, and the electrical equipment is nearly complete. Another important line is that in Hulme Hall Lane, where some great city improvements have lately been carried out, including a reduction of the street gradients. There is another subsidiary line, but an important one, from Ashton New Road, by way of Pottery Lane to Gorton Lane, Openshaw. This opens a communication between populous working-class districts which previously were ill-provided for. When this and some smaller works are completed in the district, the circular tram route on the northerly side of Manchester, extending from Cheetham Hill to Belle Vue, will have been completed. Access by electric car will be obtained from the latter place by way of Dickenson Road and Moss Lane East to Upper Chorlton Road, on the south, so that inter-communication with the suburbs, without passing through the centre of the city, will be complete. It is announced that the construction of the lines authorised by the Manchester Southern Tramways Act of last session will be begun early in the new year. The powers conferred by this Act are now vested in the Manchester Corporation, who have uncontrolled access to all the district towns and suburbs. The tramway authorities propose to institute a parcel-carrying service for Manchester and the suburbs, by electric car, very shortly. A revised passenger fares on all the principal tram routes came into operation on the 1st inst.

Manchester and Bolton.—There is a portion of the highway at Clifton—a length of about 1½ miles—over which tramways still require to be laid in order to complete the connection between Manchester and Bolton. The work is proceeding. Upon its completion a through service of cars will be started.

Perth.—The T.C. has appointed a committee to carry out the reconstruction of the Corporation tramway undertaking within and without the burgh from horse to electric traction.

Pontypridd.—At a meeting of the Electrical and Tramways Committee of the D.C. a letter was read from the British Electric Traction Co. with reference to the purchase of the company's tramway within the Pontypridd area from Hafod Bridge into the town. The company offer to accept £6,050 for the permanent way and all connected therewith, and in addition pay a proportion of the cost of the Act of Parliament. The Committee decided to have the property valued.

(*Continued on page* 587.)

THE BEXLEY ELECTRIC LIGHTING AND TRAMWAY UNDERTAKING.

The recently opened electrical installation of the Bexley Council possesses several features of extra interest in these days of prosaic low-tension systems and compact areas.

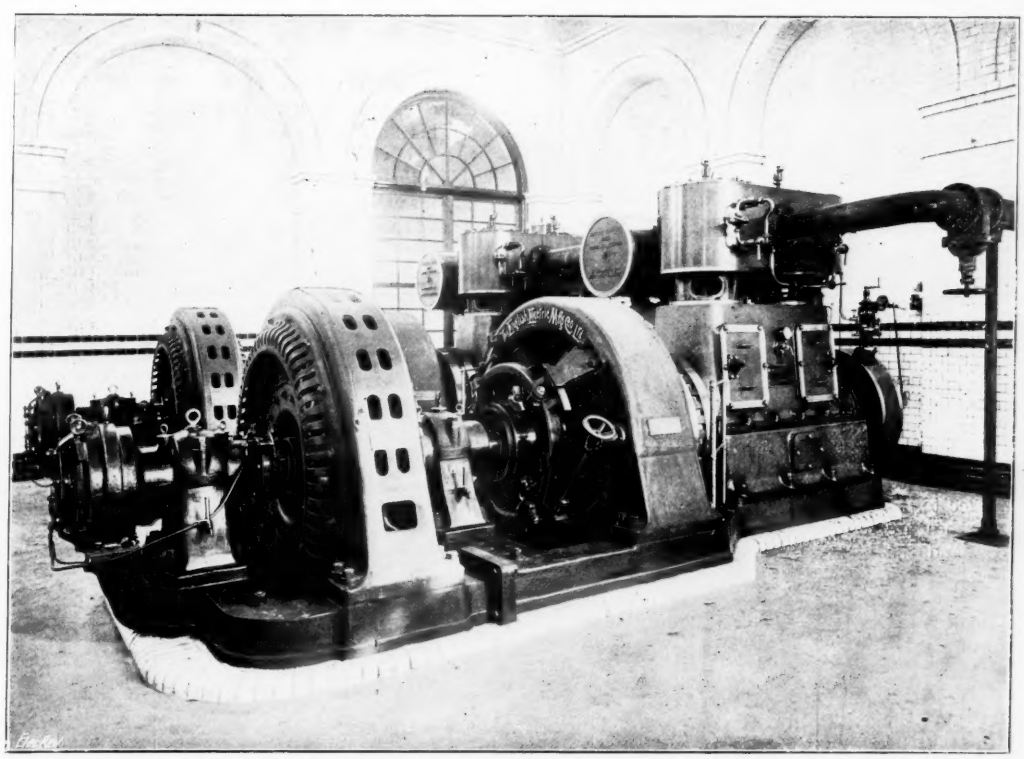
The District Council's area, which has recently been extended by the addition of East Wickham, embraces about 10 square miles, and has a population of about 15,000. By the addition of East Wickham the area also now adjoins the Metropolitan Borough of Woolwich. The latter town has long been greatly congested, and when the Arsenal is working at full pressure, working men have the greatest difficulty in obtaining accommodation of any sort, whilst houses suitable for working men with families are almost unobtainable within the limits of their means. The eastern extremity of Woolwich is already built up, and further growth must necessarily occur within the Bexley district.

Bexley Heath stands on high ground, and from many points of view is a most desirable residential district. In consequence, a demand has grown up for better means of communication between Bexley and Plumstead, where the existing horse tramways of the Woolwich and South-East London Tramway Co. now terminate.

The original incentive to the Council's operations was supplied by private enterprise, to frustrate which a provisional electric lighting order was obtained in the Parliamentary Session of 1899. Towards the end of the same year two private tramway schemes to serve the district were mooted, with the result that the Council asked Messrs. Mordey and Dawbarn, their consulting engineers for the lighting scheme, to consider the advisability of combining with it a tramway system which should provide the necessary travelling facilities for this rising neighbourhood.

Owing to the very scattered character of the residential portions of the area, and the comparatively small population and revenue which might reasonably be anticipated, the engineers were led to deal with the problem by adopting alternating low-tension distributing networks, fed through transformers and high-tension feeders, for the lighting service, and direct-current plant of the usual type for the tramways.

The generating station is situated in Bexley, one mile from the nearest point of the tramway at Bexley Heath. The site was selected so as to be near the railway, in order to get the benefit of cheap transit for coal, and also to make use of the River Cray for condensing purposes, with the further object of reducing to a minimum the consumption of fuel The generating plant comprises, at present, two engines of 150 KW. each, but space is provided for two additional sets



View of Engines and Generators.

Each engine is coupled to two generators, one being a 16-pole single-phase alternator of 150-KW. capacity, constructed to run at 2,100 volts, 50 cycles per second, and the other a direct-current compound wound 4-pole tramway generator of similar capacity, with a voltage of 550.

The alternator is of the revolving field type, the rotor spider being of cast-iron. On the spider rim dovetailed laminations are carried, which receive the pole-pieces, adequate ventilation being provided for. The pole-pieces themselves are of laminated steel, held together between two cast-steel end plates. The upper part is of T shape construction, designed to hold the field coils in position, the lower part being dovetailed for fixing on to the rim of the rotor, and both are held in place by means of keys.

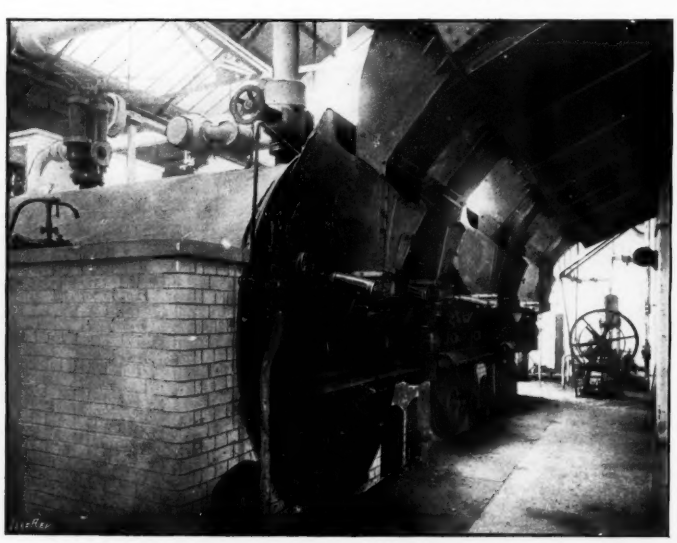
The removal of the field coil is effected by sliding the pole-pieces on the dovetailed grooves parallel to the shaft, and this can readily be effected when the shield is removed from the frame of the alternator. The stator frame is built in two halves, and the winding is made up of separate coils,

well insulated, having great rigidity, and well-defined mechanical shape. These are wound and embedded in rectangular slots and held in position by wooden wedges.

General View of Works, Bexley.

The connections between the stator coils are made by means of highly insulated cables, and are easy to trace and locate.

The brushes are of carbon, and the whole brush-gear is so constructed that current is not passed through any moving parts. The exciter is carried on a bracket, on the outside of the end bearing, and is of a form of construction very largely adopted on this size of machine. These generators were manufactured by Messrs Dick, Kerr & Co.



View of Boiler House showing Pumps, &c.

By the above arrangement it is only necessary to run one engine until such time as the combined tramway and lighting loads exceed 150 kw. The effect of this on the economical working of the plant will be readily appreciated by all station engineers. The engines were constructed by Messrs. Browett, Lindley & Co., of Patricroft, and are of the enclosed vertical compound type, constructed to drive 285 i.h.p., with a speed of 375 revolutions per minute. The steam for the engines is passed through Schmidt's superheaters, and the engines are fitted with Schmidt's patent reheaters, by which the steam, in passing to the high-pressure cylinder, gives up a proportion of its superheat to the steam entering the low-pressure cylinder, thus reducing the temperature of the steam as it enters the high-pressure cylinder to about 550° F., or a little below 200° superheat, the steam itself having been initially superheated 300°. The engines are fitted with sensitive governors acting on the high-pressure cut-off. They are also fitted with a device for controlling the speed whilst running, within a range of about 5 per cent., to facilitate paralleling the alternators.

With a view to obtaining the best possible load factor, a battery of 240 cells, supplied by the Hart Accumulator Co., has been installed, and is to be worked in conjunction with an automatic Highfield motor-booster, which will have the effect of smoothing out, as it were, the great irregularities which are inherent to the demands for energy by an electric tramway. Thus, whilst the energy furnished to the tramways will fluctuate from zero to an amount considerably exceeding the normal full load of one engine, the engine itself will be subjected to a steady load a little in excess of the mean of these fluctuations. The battery is composed of standard lighting type cells in lead-lined wood boxes. It is capable of giving 50 amperes at 500 volts for eight hours, 200 amperes for one hour, and 400 amperes for a short period.

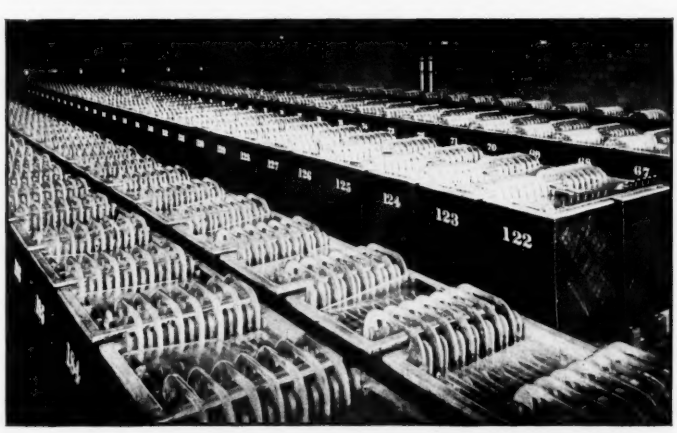
The Highfield combination consists of three machines—a motor, booster and exciter, coupled together, and running at 950 revolutions per minute. The motor and exciter both work off the tramway bus-bars, and the booster will give a maximum voltage of 120, a normal current of 200 amperes, and a maximum of 400 amperes.

This set, which was supplied by the Electrical Construction Co., of Wolverhampton, is situated in a recess at the side of the engine room, where also are a rotary converter and a small auxiliary switchboard.

The rotary was supplied by the Phœnix Dynamo Co., of Bradford, and is a 20-kw. machine, running at 1,500 revolutions per minute. Its function is to supply the late lighting load at night, from the battery, enabling the rest of the plant to be shut down.

The small auxiliary switchboard controls the station lighting and motor circuits and certain arc lamps.

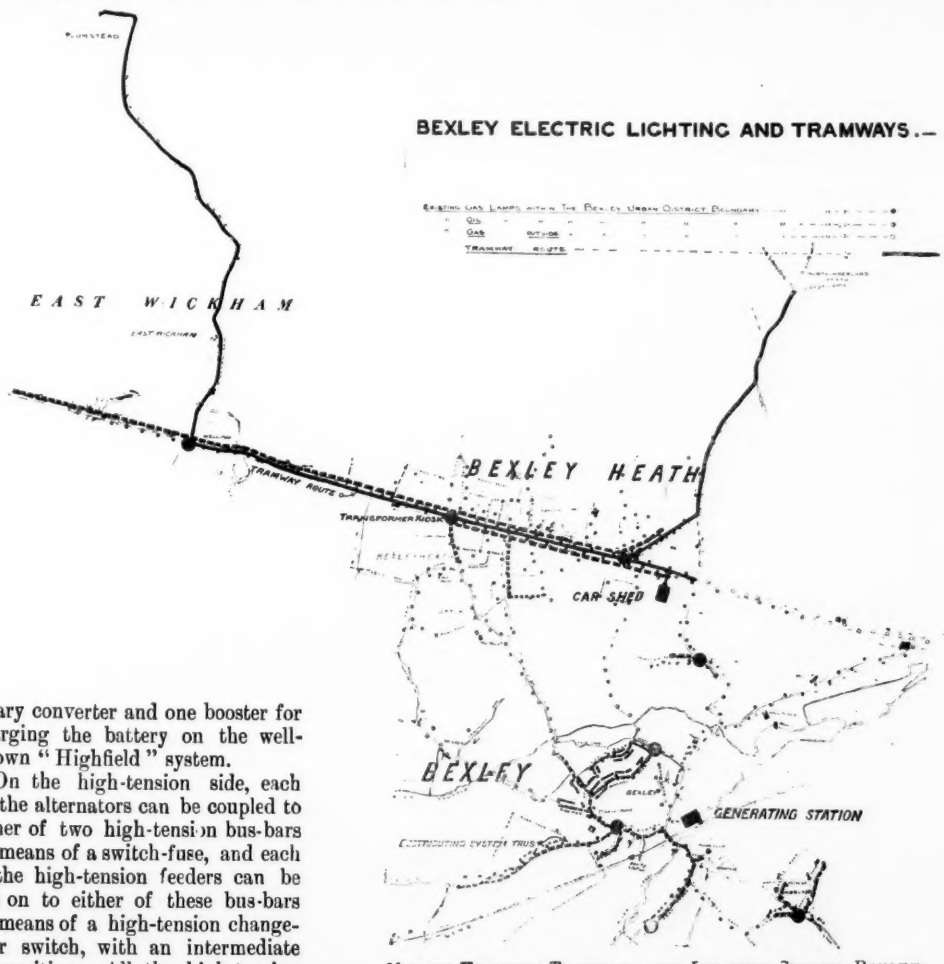
The main switchboard was supplied by Messrs. Johnson and Phillips, and measures 29 ft. long. The panels which control the alternating current plant are of white marble, whilst, for the purpose of making a permanent distinction, the tramway panels are of polished black slate.



Hart Storage Battery.

The switchboard is arranged for controlling two alternators, eight high-tension feeders, two continuous current dynamos, three continuous current tramway feeders, one rotary converter and one booster for charging the battery on the well-known "Highfield" system.

On the high-tension side, each of the alternators can be coupled to either of two high-tension bus-bars by means of a switch-fuse, and each of the high-tension feeders can be put on to either of these bus-bars by means of a high-tension change-over switch, with an intermediate off position. All the high-tension switches are of the horn-break type, the switches having laminated brushes and special spark-taking brushes, to prevent the laminated brushes getting damaged. Each alternator has a double-pole high-tension switch, single-pole switch-fuse on the high-tension outer, two-way switch-fuse on the high-tension inner, an ammeter, a voltmeter and a field-regulating switch.

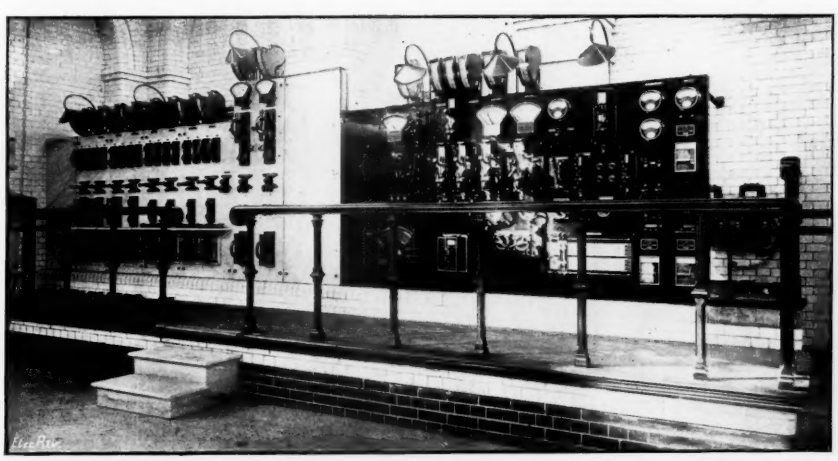


Map of Electric Tramways, and Lighting System, Bexley.

Each of the two direct-current dynamos has a maximum current circuit breaker, single-pole switch, field-breaking switch and resistance, an ammeter, a voltmeter and a shunt regulating switch. The tramway feeders each have a single-pole switch and a single-pole circuit breaker.

The rotary converter has a starting switch, circuit breaker, change-over switch, an ammeter, a voltmeter, and a synchronising switch and lamp.

The booster generator panel has all the usual switches and



View of Lighting and Traction Switchboard.

Each of the high-tension feeders has a high-tension change-over switch, single-pole switch fuse on the outer, two single-pole switch fuses on the inner, watt-hour meters, &c., so that the feeders can be supplied from either of the high-tension bus-bars. There is also a switch for paralleling these two bus-bars.

instruments in accordance with the Highfield system of battery charging.

The engine room presents a bright appearance, being well lighted, and faced with glazed bricks right up to the roof. A five-ton travelling crane, by Messrs. Carrick & Ritchie, is provided, worked by means of chains from the floor.

The boiler house contains three Lancashire boilers, by Messrs. John Fraser & Son, of Millwall, with space for a fourth. Two Schmidt patent flue-fired superheaters, capable together of heating 6,000 lbs. of steam per hour to a temperature of 660° F., the steam pressure being 140 lbs. per square

Transformer Kiosk.

inch, are arranged at the back of the boilers, and were supplied by Messrs. Easton & Co., of Erith. The boilers are 23 ft. 6 in. long and 7 ft. 6 in. diameter, and are fitted with Bennis sprinkling stokers, the latter driven by a Phœnix direct-current motor, from the tramway omnibus-bars. The hoppers of the stokers are fed by the inclined spouts above them. The bunker measures 28 ft. × 24 ft. × 3 ft. 6 in., and is arranged on a platform at the side of the boiler house, reached by an inclined roadway, which permits of the coal being shot directly into it from carts. The boiler house also contains the condensing plant, which comprises a Cole, Marchent and Morley compound steam-driven air pump of the Edwards pattern. The condenser is of the simple jet type, and is capable of dealing with 7,500 lbs. of exhaust steam per hour, the condensing water being drawn up from a brick suction chamber formed at the side of the River Cray, in the rear of the station.

A fuel economiser containing 96 tubes, constructed by Messrs. Arthur Lowcock, Ltd., of Shrewsbury, has been erected at the base of the chimney, the scrapers being driven by a 2-B.H.P. Phœnix Co.'s continuous current motor.

The feed water is also obtained from the river, being pumped up by a small auxiliary belt-driven pump of Messrs. Hayward Tyler's make, into a storage tank situated in one corner of the boiler house. The water is treated in a Braun-Lowener water softener, supplied by Messrs. Lassen & Hjort; the plant is specified to deal with 1,000 gallons of feed-water per hour, and the heat necessary for the process is obtained from the feed pump exhausts.

Two Weir feed pumps are provided, one of which is a stand-by; each has a capacity of 1,500 gallons per hour.

The boiler room, like the engine room, is extremely well lighted; the superheaters and the boiler fronts are faced with white glazed bricks. The whole of the steam and feed piping and valvework was supplied by the Sir Hiram Maxim Electrical and Engineering Co., Ltd.

A fitter's shop easily accessible either from the engine or boiler room, a suitable store room, and excellent lavatory arrangements, which include a bath room, are provided. An engineer's office and the battery room complete the building arrangements. The battery room has been arranged to be entirely shut off from the engine room, and is only accessible from outside.

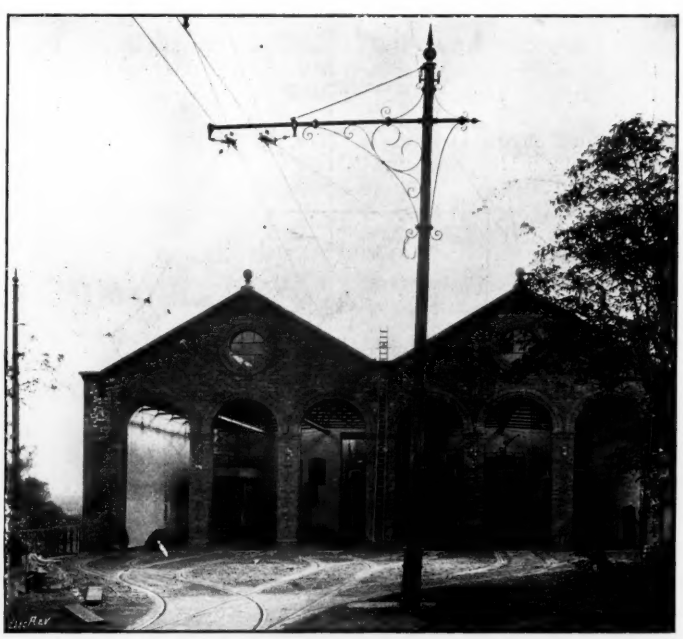
The buildings appear to be substantially and well built, and have a handsome appearance; the chimney is octagonal, and about 100 ft. in height, with an internal diameter of 4 ft. 6 in. The contractor for the buildings was Mr. Arthur Faulks, of Loughborough.

The whole of the cables have been supplied by the Anchor Cable Co., of Leigh, Lancs. The high-pressure cables which are to work at 2,000 volts, are of the concentric type, insulated with paper and lead sheathed. They are laid in stoneware troughs filled in solid with bitumen. The low-pressure distributing cables are triple-concentric paper-insulated, laid on the solid system, and working at a pressure of 200 volts on each side of the middle wire, which is earthed at the transformers. The transformers are, in all cases, placed in iron kiosks above ground. Eight of these have been supplied, up to the present, by the British Westinghouse Co. They contain 15-KW. or 25-KW. Westinghouse transformers in the upper portion, for reducing the H.T. feeder voltage down to that employed in the distributing network.

In the lower portion of the kiosk, is installed the switchgear for controlling the H.T. feeder and four 3-wire distributing circuits. There are also two Wright maximum demand indicators, and a recording earth ammeter for registering earth currents on the middle wire, as specified by the Board of Trade, is connected up to the L.T. distributing network.

The length of high pressure lighting feeders is about 10 miles, and the low pressure distributors will in the course of a few weeks amount to 8½ miles, exclusive of the street lighting cables, which serve about 14½ miles of streets with 260 lamps. Of these 110 are to be 60-C.P. Nernst lamps and the remainder 32-C.P. glow lamps.

About 2,000 8-C.P. lamps have been applied for in connection with the private lighting, the price adopted being 6d. per Board of Trade unit, with discounts for prompt payment. It is not proposed to charge meter rents. As the price of gas, supplied by the local gas company, is in the region of 4s. per 1,000 cb. ft., the introduction of the electric light should prove a boon to the district.



View of Car-Shed, Bexley Heath.

The tramway at present extends from the Erith boundary, Northumberland Heath, to High Street, Plumstead, the last part being within the Woolwich borough area.

The line, which is for the most part single track with passing places, lies through Bexley Heath, East Wickham and Welling, and ends at the terminus of the Woolwich and S.E. London Tramways Co. at Plumstead, the total length

being 5¼ miles. The contractors for the permanent way were Messrs. J. G. White & Co., and for the overhead equipment and cars, Messrs. Dick, Kerr & Co. The tramway rails weigh 90 lbs. per yard, and are of Belgian make, the contractors being Messrs. Alex. Penney & Co. The points and crossings were supplied by Messrs. Hadfields Steel Foundry Co., Ltd.

The track is standard 4 ft. 8½ in. gauge, paved partly with basaltic lava and partly with granite setts.

Overhead Construction.

The overhead construction is carried out on the bracket arm and span wire systems. The former is used over single and the latter over double track.

The poles are lap-welded mild steel, in three sections. They are of three sizes: the No. 1 pole, used for straight line work; the No. 2 pole, used on curves where pull-offs are necessary; and specially heavy anchor poles, which are adopted at the ends of the line, and in the neighbourhood of the railway bridge at Wickham Lane.

type have been provided; each will accommodate 22 passengers inside and 30 out. The car bodies were constructed at the Electric Railway and Tramway Carriage Works, Preston, and are mounted on Brush standard pattern trucks.

The electrical equipment, which was furnished by Messrs. Dick, Kerr & Co., includes two 25-H.P. motors and solenoid blow-out controllers. There are also the usual lamp and bell circuits, the headlights, however, being removable brass lanterns fitted with parabolic reflectors. The cars are also fitted with enclosed type trolley standards, life-guards of the Tidswell type, hand and electric brakes and platform gates. The cars are substantially constructed, and present a handsome appearance internally.

The capital expenditure authorised for the combined scheme amounts to £103,800, of which sum the tramways undertaking, which includes the generating station and tramways plant, is responsible for about £88,000, the remainder being for the generators, transformers, and mains for the lighting supply. The consulting engineers for the scheme

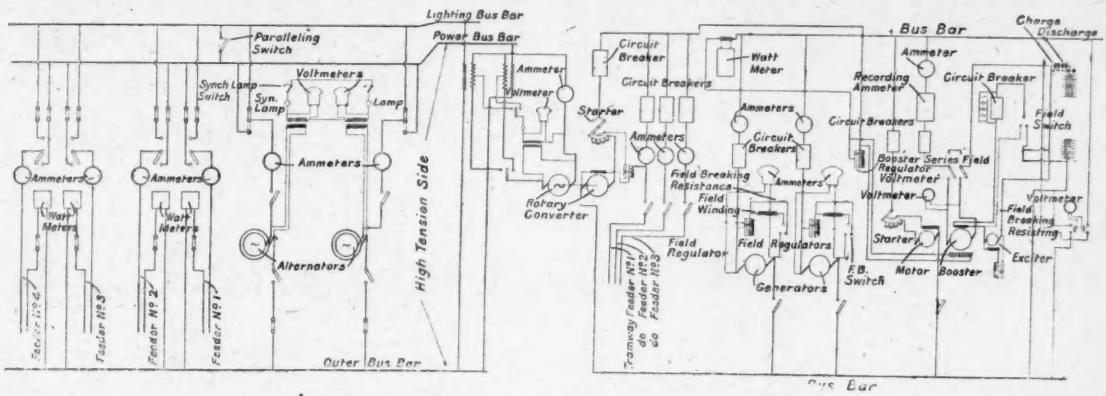


Diagram of Lighting and Traction Switchboard, Bexley.

The trolley wire, which is double throughout, is ·324 in. in diameter, equal to No. 0 S.W.G. It is flexibly supported under all brackets with a view to obtaining smooth running of the trolley. The trolley wire is fed at every mile, where feeder pillars are erected having a main feeder switch and four 100-ampere fuses for protecting and disconnecting the various trolley wire sections. The trolley wire is divided into ½-mile sections in the usual way.

An interesting feature in connnection with this line is the adoption of a complete installation of automatic electric signals of the Harison-Jones type for regulating the working of the cars on the single line, between passing places which are not visible one from the other. The signals are arranged so that when a car approaches a passing place, and the line is clear to the next passing place, the signal just in front of this car is lowered; should a car be on the single line, however, this signal will remain at danger. If the line is clear and the car proceeds, it automatically lowers the signal, which is immediately released, and the signals are locked at danger at both points. When this car has reached the other loop a contact is made which unlocks both signals, and leaves them workable for other cars coming in either direction. Each semaphore is fitted with a preference coil apparatus, which gives cars coming in either direction a preference to pass through, and which can be adjusted for either signal as the local working conditions require.

The tramway feeders, six in number, are insulated with vulcanised bitumen, and laid solid in wooden troughs. They, as in the case of the lighting cables, were supplied by the Anchor Cable Co.

The car-sheds, which are situated at Bexley Heath, were erected by the contractor for the generating station, and are of similar design. Six tracks are provided in the two bays, and steel roller shutters for the doorways.

There is a paint shop, blacksmith and carpenters' shops, as well as a mess-room, office and stores. The whole of the tracks are supported on 9-in. cross brick piers placed at short intervals, thus leaving the space below the tracks open for purposes of car inspection and repairs. Efficient water and lighting services are also provided. Up to the present 12 cars of the double-deck reverse-stairway

are Messrs. Mordey & Dawbarn, of 82, Victoria Street, Westminster. The whole of the plant appears to be of excellent construction and well arranged, and if the sanguine expectations of the local authorities, in regard to the rapid building extension within their area, are realised, a prosperous future should await the combined undertaking.

ELECTRIC TRACTION NOTES.

(*Continued from page* 582.)

Reading.—Mr. Binns, tramway engineer and manager for the Town Council, has made the following minute on a circular from the Board of Trade with reference to the construction of electric tramcars:—"In my opinion, some of the Board's suggestions are impracticable, and the adoption of certain others would not be conducive to the public safety. Such of them as are free from these defects have already been adopted on the tramcars of this Corporation."

Spen Valley.—The extension of the B.E.T. Co.'s tramways from Liversedge to Gomersal and Birkenshaw has now been completed, and trial cars were run over the section last Friday. The inspection was satisfactorily carried out, and everything appeared to be in good order. For the running of the cars from Liversedge to Birkenshaw, the energy is supplied by the Cleckheaton District Council. It is a single line, and almost joins up to the Bradford Corporation's system at Birkenshaw. It is expected that the line will be opened to the public shortly. It will then be possible to travel from Dewsbury to Bradford by tram for 8d., and from Heckmondwike to Bradford for 6d. In the near future lines are to be constructed from Birkenshaw to Drighlington, Morley and Charwell, and it will then be possible to travel from Dewsbury and Spen Valley by tram to Leeds.

Wolverhampton.—A meeting of the members of the Tradesmen's Association was held on Wednesday in last week, to discuss the tramway question, when the following resolution was passed:—"That this meeting of the Wolverhampton Tradesmen's Association requests the Town Council to equip the Sedgley Road and Willenhall Road on the overhead system at the earliest possible moment, with a view to promptly securing proper and adequate inter-communication." The Tramways Committee met on Friday, and this resolution was placed before them. The Committee then debated whether the extensions should be carried out on the overhead or the Lorain system, and finally a resolution to equip the

additional routes with the latter was carried; two members of the Committee abstained from voting, and one voted against. A detailed comparative statement showing the estimated capital and annual costs of the overhead and Lorain systems, prepared by Mr. C. E. C. Shawfield, the borough electrical engineer, was placed before the members of the Committee, and appended is a summary of the estimated capital and annual expenditure on proposed new routes:—

CAPITAL EXPENDITURE.

Double track constructed, wherever possible, on all routes except Wednesfield Road.

Item.	Lorain system.	Overhead. All cars fitted with skates.	Difference between Lorain and overhead.	ANNUAL EXPENDITURE. Lorain system.	Overhead. All cars fitted with skates.	Difference between Lorain and overhead.
Dudley Road	£19,812	£17,121	£2,691	£1,773	£1,477	£296
Wednesfield Road ..	12,882	11,926	956	1,421	1,318	102
Willenhall Road:—						
Five ways to Coventry Street.. ..	16,775	14,799	1,976	1,534	1,387	147
Coventry Street to Deans Road.. ..	5,142	4,549	593	654	596	58
Waterloo Road ..	15,378	13,694	1,684	1,397	1,271	126
	£69,989	£62,089	*£7,900	£6,779	£6,050	£729*
			£7,140			£763

Single track constructed on all routes except Dudley Road.

Dudley Road	£19,812	£17,121	£2,691	£1,773	£1,477	£296
Wednesfield Road ..	12,882	11,926	956	1,421	1,319	102
Willenhall Road:—						
Five ways to Coventry Street	14,072	13,240	832	1,408	1,314	94
Coventry Street to Deans Road . ..	5,142	4,549	593	654	596	58
Waterloo Road ..	11,337	10,609	748	1,210	1,127	83
	£63,265	£57 445	*£5,820	£6,466	£5,883	£633*
			£5,061			£666

* If Bilston Street, Piper's Row, Cleveland Road to car depôt is equipped with the overhead system, the figure immediately under the one marked * is to be taken.

TELEGRAPH AND TELEPHONE NOTES.

Brighton Telephones.—On Monday, the 5th, the Mayor (Alderman J. C. Buckwell) officially opened the new municipal telephone system by ringing up several councillors in succession from his office. His Worship then, accompanied by the members of the committee and representatives of the local press, adjourned to the exchange and made an inspection, being conducted round by Mr. J. C. Barnes, the manager, and Mr. A. R. Bennett, the consulting engineer. The exchange, which occupies a very central position, is situated in a part of the Pavilion specially altered to suit its requirements. The main switchboard occupies the whole of the side of the switch-room, and is at present equipped for 1,000 subscribers with an eventual capacity for 5,000, and as the number of applications at present exceeds 1,000, the work of carrying out the necessary extensions is to be proceeded with at once. The board works on the central battery system, with a few modifications introduced by Mr. Fennett. The cables enter the building in the basement, and are then carried to a test and distributing frame, whence they are carried to the switchboard above. The wires near the exchange are all laid underground, and radiating from this centre in all directions are about 25 miles of ducts, some of which were laid some time ago when the tramways were being constructed. Up to the present, only about 3½ miles of cables have been drawn in, and only the subscribers near the exchange are connected up, but this work is proceeding as rapidly as possible. Beyond the limits of the borough the wires are run on poles, and about 56 miles of wire has been run in this way, some of which extends to Shoreham; 246 poles and standards have been erected. Last week the work of laying the ducts in Hove, which will extend for a distance of 4½ miles, was concluded. It is hoped to open the lines to Burgess Hill and Rottingdean in December, and to Steyning in January. The whole of the instruments and the switchboard were supplied by the Ericsson-Bell Co., of Glasgow, the cables by the British Insulated and Helsby Cables Co., and the ducts were laid by Henley's Telegraph Works Co., of London. The overhead work and connecting subscribers is being done by the Council's own staff.

A Dutch and German Telegraph Agreement.—For the purpose of establishing telegraphic communication with their Colonial possessions in Asia, the Dutch and German Governments have come to a mutual understanding covered by an agreement of seven clauses:—

In Clause 1, the Dutch Government undertake to lay and work a cable between Balikpapan, Borneo, and Menado on the north coast of Celebes, to join other cables in course of construction between Laudangen, Java, and Bandjermasin and Balikpapan.

In Clause 2, the two Governments agree to form a Dutch-German enterprise, under their joint control, to lay a cable between Menado and the Palau Islands, Yap Island and Guam, or some other point on the American Pacific cable route. A cable is also to be laid from the Palau Islands to Shanghai. The German Government reserve to themselves the right to lay and work communication between Yap Island and the American system.

In Clause 3, the Governments accord landing rights for 40 years for the cables mentioned, and reserve to themselves the right to work the instruments by their own operators, and demand that tariffs are to be submitted for their approval.

Clause 4 provides for a subsidy of £70,000 for 20 years, of which £18,750 will be paid by the Dutch and £51,250 by the German Governments. The latter Government's share may be reduced in proportion, should they decide to lay the cable between Yap Island and the American system, by the ratio this cable bears to the length of the other cables referred to in Clause 2. The subsidy of £70,000 will be reduced every year by a sum equivalent to 90 per cent. of the cable receipts. No reductions from subsidy will be made on account of interruptions if another route be furnished to senders, which has been approved by the two Governments. If this is not done, the subsidy may be partly or entirely withheld. Any deductions from subsidy will be divisible between the Governments in proportion to their contributions to the subsidy.

In Clause 5, the Dutch Government grant landing rights and special landlines for eventual extensions west of the Dutch East Indies. The company may work the land lines themselves, and the terms are to be mutually settled later.

Clause 6 provides for the granting of similar privileges to this company as are granted to competing companies if they prove detrimental to the company's interests.

Clause 7 provides for arbitration.

Glasgow Telephones.—At last week's meeting of the Corporation Mr. Russell gave notice of the following motion:—"That in consequence of the divided opinion of the Corporation as regards the present and future value of the telephone undertaking, it be remitted to the Telephone Committee to call in the services of an expert in order to report to the Corporation as to the present state and value of the plant, and probable depreciation that will require to be given effect to in order to avoid loss when the undertaking will be sold to the Government at a fair value 10 years hence."

Melbourne Telephones.—A Sydney paper says that the Postmaster-General is considering the establishment of uniform telephone charges for uniform services in all the States. Sir Philip Fysh hopes to be able to reduce the charges in some of the States without loss of revenue; but thinks that it will be ill-advised to make any specific promises until the Cabinet has been consulted. Having received reports from America on the successful working of automatic switchboards, the Postmaster-General is having an estimate prepared of the cost of one for 50 telephone subscribers in the Commonwealth. It will be built as an experiment, and, if successful, they will be generally adopted. The Government has abandoned for the present its intended appointment of an electric expert from England or America to advise in connection with the telephone and telegraph systems. Sir Philip Fysh recognises the advantages that would accrue if the systems were placed on a uniform and up-to-date basis, but the amount of money involved in doing this would run into many thousands of pounds, not at present available. The proposed appointment has been postponed indefinitely, or until Parliament provides a loan for the purpose of carrying out metallic circuits and other improvements.

New American Cable.—It has been officially announced that a cable has been laid by the Government of the United States of America between Juneau and Sitka (Alaska).

Spanish Telephones.—The Minister of the Gobernacion of Madrid is receiving offers for the concession of the installation and working for a period of 20 years of a system of telephones of which the exchange will be situated at Palamos, with branch lines to San Felin, de Guixols and Palafraggel.

Telegraphic Interruptions and Répairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara No. 1	Aug. 27, 1901 ..	..
Dominica-Martinique	May 7, 1902 ..	..
St. Lucia-Martinique	May 7, 1902 ..	..
Guadeloupe-Martinique	May 7, 1902 ..	..
Puerto Plata-Martinique	July 10, 1902 ..	..
Cayenne-Pinheiro	Aug. 13, 1902 ..	..
St. Lucia-St. Vincent	Sept. 19, 1902 ..	..
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902 ..	..
Paramaribo-Cayenne	Feb. 27, 1903 ..	..
New York-Haiti	April 13, 1903 ..	..
Bolama-Bissao	Aug. 4, 1903 ..	..
St. Jacques-Haiphong	Sept. 28, 1903 ..	..
Landlines		
Communication with Puerto-Barrios ..	.. July 28, 1903 ..	..
Siberian lines between Omsk-Tomsk ..	.. Oct. 3, 1903 ..	October 3

Wireless Telegraphy.—A Dalziel despatch from Paris says that a regular wireless telegraph service will shortly be established between Great Britain and France, under the auspices of the Western of France and the London, Brighton and South Coast Railway Companies. Wireless telegraph stations have been equipped at Newhaven and Dieppe.

Tramcar Speeds.—Several L.U.T. Co. car drivers were summoned at Brentford on 2nd inst., for fast driving, 15, 16 and 18 miles being their alleged speeds. These figures the drivers denied, and an adjournment was granted to allow witnesses to be called. Mr. Montague Sharpe said that the drivers did not appear to know at what rate they really travelled. He failed to see any difference between them and motorists.

CONTRACTS OPEN AND CLOSED.

OPEN.

Army Contracts.—Electrical stores, scientific instruments, wires, and sundry other stores for the War Department. See "Official Notices" to-day.

Belgium.—October 14th. Tenders are being invited until the 14th inst. by the Belgian State Railway Authorities at La Bourse, Brussels, for the supply of 205,000 metres of electric arc lamp carbons.

G.W.R.—October 19th. Tenders are wanted for a year's stores, including electrical lamps, carbons, telegraph apparatus and instruments, copper and other wire. See "Official Notices" October 2nd.

Halifax.—October 21st. 750-KW. continuous current dynamo and horizontal engine; two Lancashire boilers; three-phase cable, for the Corporation. See "Official Notices" to-day.

Harrismith.—October 19th. Water-tube boilers, 25 and 80-KW. steam alternators, and other plant. See "Official Notices" September 25th.

Johannesburg.—November 16th. Gas producer plant; gas engines and dynamos. Alternative:—Water-tube boilers, steam engines or turbines, electric generators, and other plant. For the municipal tramways and electrical supply scheme. See "Official Notices" August 28th.

Kilmarnock.—November 18th. Lancashire boilers; engines and dynamos; crane; battery; and switchboard for electricity scheme. See "Official Notices" to-day.

King's Norton.—October 10th. Overhead construction for three miles of line. See "Official Notices" September 25th.

Leeds.—October 17th. Surface condensing plant for the electric lighting department. See "Official Notices" October 2nd.

London.—November 3rd. Engine, dynamo, wiring, &c., for an installation at the Abbey Mills Pumping Station at West Ham, for the L.C.C. See "Official Notices" October 2nd.

Nelson.—October 19th. One 400-KW. engine and dynamo. See "Official Notices" to-day.

Paris.—October 15th. The Under-Secretary of Posts and Telegraphs, 103, Rue de Grenelle, Paris, is prepared to receive offers for the supply of all switchboards for telegraphic and central postal telephones. Conditions from above mentioned.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Roumania.—October 10th. Tenders are being invited until October 10th by the Roumanian State Railway Authorities in Bucharest, for the installation of a complete electric lighting plant at the railway works in that city.

Salford.—October 19th. Sundry machinery for the Pendleton central car depôt. See "Official Notices" September 25th.

Salford.—October 19th. Electric lighting of the Pendleton Central Car Depôt. Specifications £3 3s., from the tramways manager.

Spain.—October 22nd. Tenders are being invited until the 22nd inst., by the municipal authorities of Aranjuez (province of Madrid), for the concession for the electric lighting of the town during a period of four years. Tenders are to be sent to El Secretario del Ayuntamiento de Aranjuez (Madrid province), whence particulars may be obtained.

Spain.—October 26th. The Municipal Authorities of Munera (province of Albacete) are inviting tenders until the 26th inst. for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Munera (Albacete).

Swansea.—October 31st. Permanent way, rails, special work, overhead equipment, cables, ducts, &c., for tramways. See "Official Notices" September 25th.

Swansea.—October 31st. Ducts, troughs, cables, wires, street boxes, &c. See "Official Notices" September 25th.

Sweden.—October 15th. Tenders are being invited by the municipal authorities of Gelfe until October 15th for the supply of six electrical cranes.

Swindon.—October 14th. Maximum demand indicators and fuse boxes for one year. See "Official Notices" to-day.

Todmorden.—October 31st. Lancashire boiler; steam dynamos, pumps, switchboard, battery, cables, crane, &c., for electricity supply. See "Official Notices" to-day.

CLOSED.

Barnstaple.—The T.C. has accepted the tender of Messrs. Alger & Co., Barnstaple, for wiring the music hall for the electric light.

Bermondsey.—On Tuesday the Borough Council considered the following tenders for the construction, supply and erection of two 300-KW steam generators, two 20-KW. feeder boosters, one 15-KW. motor balancer, and sundry switchgear and connecting cable required in connection with the extensions in Rotherhithe:—

SCHEDULE I.—Tenders for Willans' triple-expansion engines.

	Amount of tender. £ s. d.	Time of completion. 1st set.	2nd set.
Electrical Co.	6,327 6 9	6 months.	
International Co.	6,696 0 0	not stated.	
Johnson & Phillips	6,740 0 0	20 weeks	20 weeks
Siemens Bros.	6,993 0 0	4 months	5 months
Bruce Peebles	7,037 0 0	3½ ,,	5 ,,
Dick, Kerr & Co.	7,088 0 0	3½ ,,	5½ ,,
Crompton & Co.	7,094 0 0	4½ ,,	6½ ,,
Mavor & Coulson	7,172 11 0	4 ,,	5½ ,,
Mather & Platt	7,266 0 0	3½ ,,	5 ,,
Electric Construction Co.	7,348 0 0	3½ ,,	5 ,,
Thames Ironworks Co.	7,706 11 0	not stated.	

SCHEDULE II.—Tenders for Belliss triple-expansion engines.

	350 revs. £ s. d.	400 revs. £ s. d.	Time for completion. 1st set.	2nd set.
Electrical Co.	6,569 17 9	6,519 17 9	6 months	6 months
Johnson & Phillips	6,595 0 0	6,740 0 0	21 weeks	5½ months
Bruce Peebles	7,167 0 0	6,985 0 0	3½ months	5½ months
International Co.	7,293 0 0	7,049 0 0	not stated	
Siemens Bros.		7,049 0 0	not stated	
Dick, Kerr & Co.	7,357 0 0	7,124 0 0	3½ months	5½ months
E.C. Co.		7,132 0 0	3½ ,,	5½ ,,
Crompton & Co.		7,141 17 0	4½ ,,	6½ ,,
Brit. Elec. Plant Co.		7,265 0 0	4½ ,,	5½ ,,
G.E. Co.		7,269 0 0	3½ ,,	5½ ,,
Mather & Platt		7,516 0 0	3½ ,,	5½ ,,

SCHEDULE III.—Tenders, including Engines other than Willans & Belliss.

	£ s. d.	Type of engine.	Time for comp'etion. 1st set.	2nd set.
Witting, Eborall	5,148 0 0	Allen*	4½ months	5 months
Electrical Co.	5,176 13 9	Allen*	6 months	
International Co.	5,327 0 0	Brush	Not stated	
Ditto	5,361 0 0	Allen*	15 weeks.	
Johnson & Phillips	5,400 0 0	Allen*	19 weeks	21 weeks
Mather & Platt	5,493 0 0	Sisson*	4 months	5 months
International Co.	5,578 0 0	Alley & McLellan	16 weeks	
Bruce Peebles	5,655 0 0	Allen*	4 months	4½ months
Brush Co.	5,706 0 0	Brush*	Not stated	
Dick, Kerr & Co.	5,792 0 0	Allen*	4 months	4½ months
Crompton & Co.	5,817 17 0	Allen*	4½ ,,	6½ ,,
Mather & Platt	5 831 0 0	Allen*	4 ,,	4½ ,,
E.C. Co.	5,854 0 0	Allen*	Not stated.	
Crompton & Co.	5,878 0 0	Alley & McLellan	4½ months	6½ months
Brit. Westinghouse Co.	5,986 0 0	Sisson	6 months	
Witting, Eborall	6,024 0 0	Howden		
International Co.	6,041 0 0	Howden	3 months	
Johnson & Phillips	6,165 0 0	Howden	21 weeks	
Ditto	6,165 0 0	Davey-Paxman	21 weeks	22 weeks
Thames Ironworks	6,218 11 0	Allen*	4 months	5 months
E.C. Co.	6,374 0 0	Galloway	4 ,,	5½ ,,
Brit. Westinghouse Co.	6,454 0 0	Howden	6 ,,	8 ,,
Dick, Kerr & Co.	6,504 0 0	Howden	3 ,,	4½ ,,
E.C. Co.	6,531 0 0	Howden	3 ,,	4½ ,,
Mather & Platt	6,569 0 0	Howden	3½ ,,	5 ,,
G.E. Co.	6,611 0 0	Howden	3 ,,	5 ,,
British Elec. Plant Co.	6,615 0 0	Howden	5½ months	
International Co.	6,663 0 0	Browett-Lindley 420 r.p.m.	31 weeks	
Brit. Westinghouse Co.	6,776 10 0	Allen*	6 months	
G.E. Co.	6,875 0 0	Davey-Paxman	3 months	5 months
Alliance Co.	7,291 0 0	Alley & McLellan	15 weeks	5 ,,
International Co.	7,592 0 0	Browett-Lindley 375 r.p.m.	31 weeks	
Siemens Bros.	8,018 0 0	Ditto	Not stated	

* The engines marked with a star in the above list are not in accordance with the specification.

Messrs. Kincaid, Waller, Manville & Dawson, consulting engineers, in a report on tenders, stated the engines included in Schedule No. I are of the same manufacture as those running in the present station, and which have so far given entire satisfaction. It would, in their opinion, be a mistake to put in a different grade engine. The Electrical Co.'s tender was the lowest in Schedule I. This company are the representatives of the Allgemeine Elektricitäts Gesellschaft, of Berlin, and all their electrical apparatus would be constructed in Germany. The trades union rate of wages as called for in the specification, could not, therefore, be enforced. The next lowest tender is that of the International Co., who are the agents for the Société Internationale d'Electricite, Liège, Belgium. The same objections apply to this firm being foreign as to the Electrical Co. in regard to the wages question. In regard to both the above foreign tenders there is an important question to be considered, namely, that of repairs and spare parts, as should anything go wrong with the electrical apparatus there will be inevitable delay owing to the factories being in foreign countries. The time of delivery of the first set for Messrs. Johnson & Phillips, the lowest British tenderers, was against them, and so the consulting engineers concluded by recommending the acceptance of either Messrs. Siemens Bros.' tender, or that of Messrs. Dick, Kerr & Co.

The Borough Council unanimously resolved to accept the tender of Messrs. Siemens Bros. with a Willans engine at £6,893.

The following tenders were received for the construction, supply and erection of two dust destructor cells with furnace, flues, &c., and storage bins, one water-tube boiler and brickwork setting, one water-storage tank with supports for same, and the consequent extensions to steam, feed and exhaust piping systems:—Messrs. Hughes & Stirling (accepted), £1,837; Messrs. Heenan & Froude, £4,754.

Bexhill-on-Sea.—The U.D.C. has accepted the tender of Messrs. Babcock & Wilcox for the supply of pipework for the electric light works, at £528 7s.

Bristol.—The T.C., on October 1st, accepted the following tenders:—Messrs. Babcock & Wilcox, Ltd., London, for boilers, at £9,324; Messrs. Oliver & Co., Ltd., for arc lamps, at £2,556; Messrs. Alley, MacLellan & Co., Ltd., Glasgow, for condensing plant, at £3,285; Messrs. Ferranti, Ltd., for switch gear, at £395 10s.; Newton Electrical Engineering Co., Ltd., Taunton, for motors, at £509; Messrs. J. P. Hall & Sons, of Oldham, for pumps, at £408; British Westinghouse Co., for exciters, at £744, and transformers, at £724; Messrs. Doulton & Co., Ltd., for water softening plant, at £352; Mr. C. A. Hayes, erection of arc lamp standards, £575.

Dewsbury.—The T.C. has accepted the tender of Messrs. Siemens Bros. & Co., of London, for a 300-KW. dynamo, with engine for the electricity works.

Dundee.—The Electricity Committee has accepted the tender of the British Insulated & Helsby Cables, Ltd., for relaying the distributing mains in the central area. The contract includes three single paper-insulated and lead-covered cables, laid solid in three chase troughing. Mr. John Carnegie, of Dundee, has received the contract for taking down the wall between the two engine rooms at the electricity works.

Epsom.—The U.D.C. has accepted the tender of Messrs. Roll & Taylor, of Epsom, for the erection of the refuse destructor buildings and shaft, at £1,474 and £295 respectively.

Hastings.—The T.C. on Friday accepted the tender of the Key Engineering Co., Ltd., of London, for the supply of Stanley magnetic suspension meters at the following prices:—75 10-ampere, £4 5s. each; 37 25-ampere, £5 10s. each; 13 50-ampere, at £7 each.

Contracts have also been recently placed with the same company by the Southport Corporation for 74 "Stanley" meters; the County of London Electric Lighting Co. for 75 meters; the Bexley Corporation for 50 meters, and by other undertakings for smaller trial orders.

London.—The following tenders have been received by the London County Council for the supply of low-tension switchboards for the sub-stations at New Cross and Camberwell:—

Bertram Thomas, Manchester (accepted)	£1,746	2	6
J. G. Statter & Co., Birmingham	1,935	19	6
The Electrical Co., London	1,984	1	0
Kelvin and James White, Glasgow	2,006	2	0
Frank Suter & Co., London	2,021	8	0
Electric Construction Co., Wolverhampton	2,026	0	0
William Sanders, Wednesbury	2,027	0	0
Siemens Bros. & Co., London	2,090	0	0
Electric and Ordnance Accessories Co., Birmingham	2,098	19	0
Cowans, Ltd., Manchester	2,110	5	0
Dorman & Smith, Manchester	2,202	0	0
British Westinghouse Co., London	2,223	0	0
Berry, Skinner & Co., London	2,270	0	0
Ferranti, Ltd., Hollinwood	2,336	0	0
A. Reyrolle & Co., Hebburn-upon-Tyne	2,482	4	0
International Electrical Engineering Co., London	2,684	4	0
Torque Electrical Engineering Co., London	2,699	3	0
Elliott Brothers, London	2,836	2	0
Clift Manufacturing Co., London	3,630	0	0
General Electric Co., London	3,639	0	0

London.—The New System Private Telephone Co., Ltd., have secured the order for installing their system of private telephones in the offices of the Metropolitan Asylums Board.

Metropolitan Asylums Board.—At the last meeting of this Board it was announced that a letter had been received from the Local Government Board sanctioning the proposal of the managers to enter into a contract with Messrs. Buchanan and Curwen, of Victoria Street, for the wiring of the Children's Home at the Tooting Bec Asylum, for electric lighting purposes, at a cost of £398, without in the first instance advertising for sealed tenders.

Newcastle-under-Lyme.—The Corporation has placed the contract for the storage battery with the Electrical Power Storage Co., Ltd.

Paisley.—Messrs. W. T. Glover & Co., Ltd., have obtained the contract from Mr. W. M. Murphy for the whole of the mains, ducts, troughing, excavation, &c., in connection with this extensive tramway scheme. The accepted price is £13,088.

Reigate.—The T.C. has accepted the following tenders for additions to its electric lighting plant:—Messrs. Babcock and Wilcox, Ltd., for one water-tube boiler, economiser and brickwork (£1,209), and for steam exhaust and other pipes (£681); the General Electric Co., Ltd., for one 200-KW. steam alternator, coupled to a Belliss & Morcom engine (£1,744); Messrs. Cowans, Ltd., for switchboard and instruments (£104); the Wheeler Condensing and Engineering Co., for condensing plant and cooling tower (£1,107). When this expenditure has been made, the Council will be in a position to double the earning power of the undertaking, which, at present, is £3,000 per year. The Electric Lighting Committee also propose to provide for another 200-KW. alternator at a cost of £4,500. It was stated that, in considering the tenders, the Committee had been careful to eliminate all German tenders and German work, as they considered that the work would be best done by Englishmen, and that English machines would be better and more durable.

Rochdale.—The T.C. has accepted the tender of the Brush Electrical Engineering Co. for the supply of new tram cars.

Stalybridge.—Twenty double-deck cars, fitted with Westinghouse motors, controllers, and magnetic brakes, were recently ordered for the Stalybridge, Hyde and Mossley Tramways, and ten additional cars, fitted with similar apparatus, are now to be supplied by the British Westinghouse Co., who are making the entire equipments at their Trafford Park works.

Stoke-on-Trent.—The T.C. has accepted the tender of Messrs. Crompton & Co., Ltd., of Chelmsford, for piping at the electricity works, at £482.

Sutton.—The tender of the New System Private Telephone Co., Ltd., for installing a complete system of private telephones in the Banstead Road Schools, Sutton, belonging to the Metropolitan Asylums Board, had been accepted.

Scarborough.—Messrs. C. A. Parsons & Co. have received an order from the Scarborough Electric Supply Co., Ltd., for the supply of two 300-KW. special traction turbo-dynamos, 450—550 volts, complete with surface condensers and air and circulating pumps; also from the Dalmellington Iron Co. for one 200-KW. turbo-dynamo, 500 volts, complete with condenser.

Wandsworth.—Messrs. McMurray's Royal paper mills, Wandsworth, were recently burned down, and the contracts for the reconstruction and electrical equipment have just been let. The directors have placed the entire reconstruction in the hands of Messrs. Handcock & Dykes, of Westminster. The original works were driven throughout by steam engines, the greater part of which, together with a number of boilers, were destroyed in the fire. Under the new scheme, while retaining four or five boilers for the production of steam for heating purposes and for working one of the paper machines, all the rest of the power will be supplied by a bituminous producer gas plant. Two out of four of the Willans 230-B.H.P. gas engines drive direct on to shafting, from which the beaters are driven, the remaining machinery, including one of the large paper machines, being electrically driven by means of continuous current 220-volt motors. The directors have satisfied themselves that when the scheme is completed in accordance with the plans the engineers have prepared, they will effect a saving in fuel, and in other directions, which will repay the cost of the new power plant in about three years.

The following is a list of tenders for two continuous current generators for direct coupling to 230-B.H.P. gas engines, main switchboard, 33 motors, aggregating 350 B.H.P., main cables for power, and electric lighting:—

Bruce Peebles & Co. (accepted)	£6,216	0	0
Bruce Peebles & Co.	6,296	0	0
G. E. Taylor & Co.	6,394	0	0
Greenwood & Batley	6,414	9	0
Siemens Bros. (exclusive of 50-H.P. Callender House motor)	6,502	0	0
Johnson & Phillips	6,506	0	0
Dawson & Co.	6,606	0	0
J. H. Holmes & Co.	6,885	0	0
Electromotors, Ltd.	6,968	10	0
Bergtheil & Young	7,028	18	0
Mather & Platt	7,034	0	0
Crompton & Co.	7,088	0	0
Marryatt & Place	7,382	0	0
Dick, Kerr & Co.	7,625	0	0
Drake & Gorham	9,460	0	0
Engineer's estimate	6,700	0	0

The tenders for four 230-B H.P. gas engines, bituminous producer gas plant, overhead traveller, and all accessories were:—

—	Sec. II.	Sec. III.	Sec. IV.	Total.	Delivery.
	£	£	£	£	
Willans Robinson:—					
Mason (accepted)	2,467	5,950	350	8,757	Accepted tender
Mond	3,662	5,950	350	9,962	37 weeks.
J. E. H. Andrew & Co.:—					
Wilson	2,484	8,088	315	10,887	Plant and 3 engines within 10 months.
Premier Gas Engine Co.:—					
Mond	3,360	7,758	280	11,398	43 weeks.
Richardsons Westgarth:—					
Mason single engines	2,467	10,270	415	13,152	Producer and three engines within 26 weeks.
Mason tandem engines	2,467	10,720	415	13,602	
Horshay single engines	2,504	10,270	415	13,188	
Horshay tandem engines	2,503	10,720	415	13,638	
Mond single engines	3,661	10,270	415	14,346	
Mond tandem engines	3,661	10,720	415	14,796	
Crossley Bros.	3,055	9,650	550	13,255	Gas plant and 3 engines in 10 months.
Power Gas Corporation:—					
800-B.H.P. gas plant	3,487	—	—	—	—
10,000-B.H.P. gas plant	3,687	—	—	—	—
Engineer's estimate	2,827	6,864	385	11,000	With contingencies.

FORTHCOMING EVENTS.

Friday, October 9th.—Holborn Restaurant (Crown Room); Electro-Harmonic Society. First Smoking Concert of the season.

Saturday, October 10th.—At 2 p.m. North of England Institute of Mining and Mechanical Engineers. General meeting at Newcastle. Election of members, &c.; the Neu-Catrice portable electric miners' lamp will be exhibited.

Wednesday, October 14th.—At 6.45 p.m. Institute of Marine Engineers. Annual Dinner at Great Eastern Station Hotel, E.C.

At 7.30 p.m. Institution of Mechanical Engineers. (Graduates' Association). Papers by Mr. Wm. McDonald on "The Design of a Town's Tramway Scheme." Prof. A. B. W. Kennedy, F.R.S., in the chair.

Saturday, October 17th.—At 3 p.m. Junior Institution of Engineers. Visit to the new Vauxhall Bridge Works.

Thursday, October 22nd.—Institution of Electrical Engineers (Leeds Section). Paper on "Some Notes on Steam Turbo-Electric Generating Plants," by G. Wilkinson.

LEGAL.

KNIGHT *v.* THE ISLE OF WIGHT ELECTRIC LIGHT AND POWER CO., LTD.

THE matter of Knight *v.* the Isle of Wight Electric Light and Power Co., Ltd., was before Mr. Justice Bucknill in the Vacation Court on Wednesday, on a motion by the plaintiff for an interim injunction restraining the defendants until the trial or further orders from committing or continuing an alleged nuisance by reason of noise, smell and vibration. On the application of counsel, his Lordship directed the motion to stand over until the next sittings.

BOND *v.* THE BRITISH ELECTRIC STREET TRAMWAYS CO., LTD.

THIS matter was before Mr. Justice Bucknill in the Vacation Court on Wednesday, on a motion by the plaintiff asking for an interim injunction to restrain the defendant company until the trial or further order from dealing with the assets of the company. On the application of counsel, his Lordship directed the motion to stand over until the second motion day of next sittings.

FRENCH ELECTRIC LIGHTING BOARDS.

THE matter of the French Electric Lighting Boards, Ltd., was before Mr. Justice Bucknill, sitting as Vacation Judge on Wednesday on a petition of the Electric Lighting Boards, Ltd., and its receiver for the compulsory winding up of the company. Counsel, who appeared in support of the petition, said the petitioners were judgment creditors, and it had been arranged that the petitioners should accept the personal undertaking of the managing director to pay a certain sum if the petition was adjourned until the first petition day of the next sittings. His Lordship adjourned the hearing of the petition as requested.

ACETYLENE GAS AND ELECTRIC SMELTING CO., LTD.

IN the Vacation Court on Wednesday, before Mr. Justice Bucknill, the matter of in *re* the Acetylene Gas and Electric Smelting Co., Ltd., and in *re* the Companies' Acts came up on a motion to rectify the register of the company by striking out the names of certain persons which had been put upon it as shareholders without their authority. The company was not represented by counsel, and his Lordship made the order asked for.

NOTES.

Trying to Avoid Electrification.—At the last meeting of the Great Northern Railway Co., Lord Allerton stated that to some extent the decision as between steam and electric power will depend on whether a steam locomotive can be designed and constructed which will give much greater acceleration, coupled with more tractive power, without unduly increasing and concentrating the weight. We now read in the *Times* that quite recently the company have introduced an engine of an entirely novel type, which has been designed by Mr. H. A. Ivatt, the company's engineer, and erected at the Doncaster works, and is now undergoing a series of experimental trials. This engine is intended to haul the heavy suburban trains over the somewhat severe gradients of the Great Northern line between King's Cross, Highgate and High Barnet, on which stretch of 11¼ miles, it is anticipated, no fewer than eight minutes will eventually be saved by the "stopping" trains. "The engine, which has quite an imposing appearance, is really one of the ordinary eight-coupled goods engines, deprived of its tender, and provided instead with side tanks of large capacity, fitted with condensing apparatus, and slightly lengthened frames, coal bunker, and a pair of radial wheels. The cylinders are 20 in. × 26 in., and the driving wheels have a diameter of 4 ft. 7½ in. The engine weighs about 80 tons, and is fitted with four safety valves instead of two, as is usual. The total heating surface is 1,438 sq. ft.; grate area, 24½ sq. ft.; and the working pressure 175 lbs. per sq. in. The tank holds 2,000 gallons of water, whilst the bunker has a capacity of 4 tons of coal. With an average cylinder pressure of 160 lbs., the tractive effort of the engine is approximately 30,000 lbs., which is expected to suffice to accelerate at the rate of 1·5 ft. per second a load of 250 tons, so that a speed of 30 miles an hour may be attained within half a minute of the engine starting."

To-Night's Electro-Harmonic Concert.—To-night at 8 o'clock the first smoking concert of the Electro-Harmonic Society for the 1903-4 season, will be held at the Holborn Restaurant (Crown Room). Mr. Martin F. Roberts, the assistant engineer-in-chief at the G.P.O., will occupy the chair. The programme is a very attractive one. The vocalists will be Messrs. Harper Kearton, George May, W. H. Brereton and Bertram Mills, also the Westminster Glee Singers. Mr. Harry Tipper will perform some silver bell solos; and Mr. Alfred Izard will render pianoforte solos. Of the humorous description there will be recitations by Mr. W. G. Churcher, songs by Mr. Fred. Stephens, and a sketch by Mr. Geo. Schneider.

London County Council.—The Council on reassembling on Tuesday decided to sanction the borrowing by the Hackney Borough Council of £906 to defray the cost of additional mains, and to lend £8,600 to the Fulham Council for electric lighting plant and meters.

The Highways Committee reminded the Council of the notice served last July by the Metropolitan District Railway Co. of intention to lay mains along Fulham Road, King's Road, Uverdale Road and Lots Road, Chelsea, as shown upon plans which were disapproved at the time. Since then the Underground Electric Railways Co. had submitted for approval cross-sections of three of the roads where the proposed mains would cross those thoroughfares, indicating the position of the sewers affected. Having considered the further particulars, the Committee stated that there appeared to be no objection to the works being proceeded with, and they had therefore sanctioned them.

It was stated by the Building Act Committee that approval had been given to plans submitted by the Charing Cross and Strand Supply Corporation for the conversion of the generating station in Maiden Lane into a distributing station. Approval was given to plans presented on behalf of the South London Electric Supply Corporation for the construction of three water cooling towers in one block and a motor house at the generating station at Loughborough Junction.

Obituary.—We regret to announce the death, at Cambuslang, near Glasgow, where for some years back he has been laid aside from active duty through ill health, of Mr. George Henry Midgley, formerly chief superintendent of postal telegraphs at Glasgow. Long before the telegraphs became State property, Mr. Midgley held responsible positions in the service of the Electric Co.—the principal concern conducting telegraphic business in pre-transfer days—which he joined, so far back as 1848, at York; and it was under him, as chief superintendent, that the staffs of the several competing telegraph companies at Glasgow—Electric, Magnetic, United Kingdom and Universal Private—were first organised in 1870 to carry on there the service thenceforward performed in connection with the Post Office. The selection of Mr. Midgley for this exceptionally responsible appointment proved not only highly acceptable to the different conflicting interests directly affected by the Government's new acquisition, but also very gratifying to the great trading community of Scotland's most important business centre, where Mr. Midgley's courteous, affable manner and particularly obliging disposition had marked him out as eminently qualified for such a post. His somewhat early demise is sincerely mourned by a wide circle of old friends.

Institute of Marine Engineers.—The Council of this Institute have awarded their Denny Gold Medal to Mr. C. W. Barnes (Assoc. Mem.) A.I.E.E., of the electrical engineering department, Northampton Institute, E.C., for his paper, "The Electric Lighting of Merchant Vessels."

Berlin High-speed Trials.—It is reported that the Siemens car on the Marienfelde and Zossen line made a maximum speed of 125 miles an hour on October 5th.

The Junior Institution of Engineers.—On the invitation of the British Fire Prevention Committee a large number of members of this Institution paid a visit to the International Fire Exhibition at Earl's Court on October 2nd.

Promotion by Merit.—An interesting scheme for the advancement of apprentices by merit has been adopted by Messrs. Richardsons, Westgarth & Co., Ltd., of Hartlepool Engine Works. Marks are given for time-keeping, good conduct and industry, and examinations passed in science and mathematics. The maximum number of marks attainable, exclusive of examinations, is 80, and apprentices who obtain 60 marks receive an addition of 6d. per week to their wages, with further increase for higher marks; as each examination counts 20 marks, it is evident that a steady and industrious apprentice may easily derive considerable pecuniary benefit from the scheme. Moreover, promotion in the workshops and admission to the drawing office depend upon the marks obtained. Altogether the scheme appears to be one which is well worthy of imitation, as it is bound to be advantageous to both apprentice and employer.

Milan Exhibition, 1905.—In 1905 there will take place at Milan a great exhibition, the programme of which includes a section for the application of electric traction to transport by land and sea, and a section specially devoted to telegraphy, telephony, &c. The section devoted to means of transport by land will be the most important in the exhibition, and, naturally, the applications of electricity will be numerous. The following is a list of the various groups devoted to electric traction:—Group I.: Central electric stations. Group II.: Electric lines and materials for the line. Group III.: Rolling stock. Group IV.: Different applications of electric traction. Group V.: Documents. The section for telegraphy, telephony, &c., is classified as follows:—Group I: Projects. Group II.: Postal materials. Group III.: Telegraph lines. Group IV.: Wireless telegraphy. Group V.: Telephone lines.

Electric Signalling.—An installation of Westinghouse electro-pneumatic signalling apparatus has been made in connection with the new station of the Lancashire and Yorkshire Railway at Bolton.

A Capital Cure for Smoke Nuisance.—We read that the Glasgow sanitary inspector, in a report on the emission of black smoke in the city, states that Messrs. Robert Laidlaw & Son, Ltd., Broomhill Ironworks, have installed motors for electric driving, with power obtained from the Corporation Electricity Department, thereby considerably reducing their load on the steam boilers. Previous to the improvements being carried out, the report alleged, this chimney was, without exception, the worst in the city. The latest prosecution diagram showed 57 minutes of black smoke in a 60 minutes' observation. Two diagrams taken since the alterations show no black smoke whatever.

The Iron and Steel Institute.—It has been resolved to hold the next annual meeting in New York on October 24th, 25th and 26th next year. After the meeting there will be an excursion to Philadelphia, Washington, Pittsburg, Cleveland, Niagara Falls and Buffalo, returning to New York on November 10th.

Fire.—Damage to the extent of £1,000 has been done by fire at the Kidderminster Electric Tramway depôt.

The Royal Traffic Commission.—The four members of this Commission who are studying rapid transit matters in America, have made an inspection of the New York underground railway work under the guidance of engineer W. Barclay Parsons.

Bexley Electricity Works Opening.—The official opening of the Bexley electric tramways and lighting systems took place on the 1st inst. After a visit to the generating station at Bexley, where the Chairman of the Council, Mr. W. V. Hudson, J.P., C.C., switched on the current, the members of the Council and their guests visited the car-shed at Bexley Heath, and made an inaugural trip over a portion of the tramway system. Subsequently a luncheon was held in the Public Hall, sundry toasts and speeches following. Among those who spoke were the chairman of the Council, Mr. W. V. Hudson, J.P., Sir W. Hart-Dyke, M.P., representative of the division in Parliament, and Messrs. Mordey and Dawbarn, the consulting engineers for the scheme. Mr. Mordey referred to the disabilities erroneously supposed to occur with an alternating system of distribution, especially in the matter of motive power supply. He anticipated no great advance in efficiency in electrical plant, as its efficiency was already exceedingly high. At the conclusion of the proceedings the chairman was the recipient of a souvenir from the contractors, who numbered some 14 in all.

Personal.—Mr. H. Babington Smith has taken up the duties of secretary to the Post Office, in succession to Sir George Murray, who has been transferred to the Treasury.

Mr. Henry M. Sayers, M.I.E.E., has left the staff of the British Electric Traction Co., and is carrying on a consulting practice at 36, Victoria Street, Westminster.

Appointments Vacant.—Switchboard attendant for Falkirk (25s.); assistant electrical engineer for Oldham (£100); shift engineer for Reading Tramways (35s.); clerk of works for Swindon Corporation tramways (£3 3s); assistant electrical engineer for Shipley (£110); switchboard attendant for the Dudley lighting and tramway power station; general clerk (£104), and switchboard attendant (30s.), for the Bermondsey electricity department. See our advertisements to-day.

THE CENTRAL STATION ENGINEER.

Mr. C. H. Yeaman, assistant electrical engineer to the Islington Borough Council, has been appointed chief assistant and distributing engineer, at his present salary of £300 a year.

Mr. Percy E. Rycroft, one of the senior engineers-on-watch at the City of London Electric Lighting Co.'s station, Bankside, has been appointed assistant engineer and works manager to the Islington electricity undertaking, at a commencing salary of £200, rising by two annual increments to £250. There were 101 applicants for the post, subsequently reduced to 12, which were interviewed by the Lighting Committee.

On Wednesday last week, at the Croydon Town Hall, Mr. J. Gray Scott, borough electrical engineer, was the recipient of a silver table set from the officials of the Corporation, to commemorate his marriage. The town clerk (Mr. F. C. Lloyd), expressed the pleasure which it gave him to make the presentation, as an expression of the good feeling that had existed between the borough electrical engineer and his brother officials of the Corporation. He had no doubt that good feeling would continue, and he wished Mr. and Mrs. Scott every happiness. Mr. Scott thanked the town clerk for his kind words, and expressed the gratitude of himself and his wife to the donors for their handsome present.

Mr. H. S. Bush, assistant electrical engineer to the Epsom U.D.C., has resigned his post, and the vacancy has been filled by the promotion of Mr. Gilling, the second assistant.

Mr. D. Tattersall has resigned the post of electrician to Mr. Harris, of Ingleton, in order to take up the position of manager to the Ingleton Electric Lighting and Power Co., Ltd.

One day last week the staff of the Morecambe Corporation electricity works were entertained at the Grand Hotel by Mr. Pape, the borough electrical engineer, who is leaving to take up the post of chief electrical engineer to the Port Elizabeth authorities, South Africa. The dinner was made the occasion of presenting him with a silver cigar and card case from the members of the staff. Alderman Carleton, chairman of the Electric Light Committee, made the presentation. Mr. Pape, in acknowledging it, said that he hoped he would have the pleasure of seeing some of the present staff out in South Africa with him. An enjoyable evening was spent; there was a capital musical programme, to which nearly every member of the staff contributed, and the evening closed with the singing of "Auld lang syne."

At a meeting of the Shipley District Council on September 29th, Mr. R. Lindley moved the adoption of the minutes of the Gas and Electricity Committee, with the exception of the minute recommending that an assistant electrical engineer be advertised for at a salary of £110 per year. He remarked that the name of a certain gentleman who had been clerk of works for the electrical equipment for the Mid-Yorkshire Tramways Co. had been prominently brought forward, and he thought it advisable that before the expense of advertising was gone to, an effort should be made to come to an arrangement with this gentleman. He suggested that the matter should be discussed in committee at the conclusion of the meeting, and the resolution was adopted. The matter was apparently settled in favour of advertising, as will be seen from our advertisements to-day.

Messrs. G. L. Badger, of London, and G. L. Stonier, of Lincoln, have been appointed junior engineers in the Dundee electricity works.

Mr. H. B. Dorrell, late of the Buxton Electricity Works, has been appointed as chief outside assistant to the Bury Council at £120, rising to £150.

The Dewsbury E.L. Committee has increased the salary of Mr. A. P. Dryburgh, assistant electrical engineer, from £120 to £150 per annum.

On Thursday, October 1st, Mr. F. A. Watkins was presented with a Gladstone bag on the occasion of his leaving the Midland Electric Corporation for Power Distribution, Ltd., to take up his duties as shift engineer at the Ipswich Corporation electric lighting station.

Mr. M. L. Gamlen, engineer and manager of the Bromley (Kent) Electric Light and Power Co, has been appointed to a similar position under the Lancashire Electric Power Co., Ltd.

Mr. J. A. T. Marsh, chief electrical engineer to the Dudley Corporation, died on Monday evening at his residence, Victoria Terrace, Dudley, from injuries sustained the previous day. Mr. Marsh paid a visit to Mr. Cartwright, at Himley, and subsequently, accompanied by Mr. J. Cartwright and Mr. T. Hanson, he journeyed to Wall Heath, all three being on horseback, their intention being to return to Dudley, *via* Kingswinford. Soon after they left Kingswinford, the horse ridden by Mr. Marsh, which was very fresh, bolted, but was kept well under control. He was unable to check the mad pace at which the horse was travelling, and on arriving at the Cross, Kingswinford, the horse, in turning the corner, slipped in the channel of the road, with the result that he was thrown from the saddle, and was hurled against the lamp-post at the corner. His leg was broken in several places, and he also sustained serious internal injury. He was at once removed to Dudley, and was attended by Dr. Messiter, who set the injured limb. On Monday Dr. Jordan Lloyd, of Birmingham, was called in, and as the result of a consultation with Dr. Messiter it was found that an operation was impracticable, and that the case was quite hopeless. The deceased gentleman, who was only about 28 years of age, came to Dudley from Dublin a few years ago, when the Corporation's electrical enterprise was in its infancy, and had since contributed very largely to the success that has been achieved in connection with that undertaking. He was a very popular Corporation official, and his untimely death will be greatly lamented by all who knew him.

NEW COMPANIES REGISTERED.

Tonyrefail and Gilfach Goch Electric Light Co., Ltd. (79,637).—This company was registered on September 24th, with a capital of £3,000 in £1 shares, to carry on at Tonyrefail, Gilfach Goch and elsewhere in Glam., the business of an electric light company, electricians, mechanical and general engineers, suppliers of electricity for light, heat, motive power or otherwise, &c. The first subscribers are:—J. Thomas, Boar's Head Hotel, Tonyrefail, hotel keeper, with 50 shares; W. Evans, Rhiwinder Farm, Tonyrefail, estate agent, with 50 shares; W. T. Rees, Danygrove House, Tonyrefail,

colliery manager, with 25 shares; D. L. Jones, London Warehouse, Tonyrefail, draper, with 50 shares; J. Llewellyn, High Street, Tonyrefail, draper and grocer, with 50 shares; D. N. Morgan, Danygraig, Gilfach Goch, surgeon, with 50 shares; and L. Jenkins, Emlyn House, Gilfach Goch, butcher, with 50 shares. Minimum cash subscription 1,000 shares. The number of directors is not to be less than three nor more than seven. The first are J. Thomas, W. Evans, W. T. Rees, D. L. Jones, L. Llewellyn, D. N. Morgan and L. Jenkins; qualification, £10; no remuneration for first year, afterwards as fixed by the company. Registered office, 138, High Street, Tonyrefail.

Wells, Rayner & Co., Ltd. (78,655).—This company was registered on September 26th, with a capital of £20,000 in £1 shares (4,000 first preference, 10,000 second preference, and 6,000 ordinary), to acquire the business of electrical engineers now carried on at 56, Paddington Street, W., as Wells & Co., to adopt an agreement with A. B. Rayner, and to carry on the said business and that of electricians, mechanical engineers, brassfounders, metal workers, machinists, smiths, carpenters, plumbers, glaziers, painters, decorators, sanitary engineers, gas fitters, ironmongers, &c. The first subscribers each with one first preference share) are:—T. H. Hewitt, 8, Smyrna Mansions, myrna Road, West Hampstead, N.W., gentleman; A. B. Rayner, 56, Paddington Street, W., electrical engineer; H. J. Chaplin, 36, Romola Road, Tulse Hill, S.E., law stationer; F. B. Hollis, 17, Bedford Row, W.C., architect; F. E. Howard, 49, Kingsley Road, Wimbledon, traveller; E. C. Rayner, Normanhurst, Alexandra Park Road, Muswell Hill, N., woollen merchant; and A. W. Towse, 156, Sheen Road, Richmond, engineer. No initial public issue. The number of directors is not to be less than three nor more than five; the first are A. B. Rayner (managing director), T. I. Cammell (appointed by first preference shareholders), and T. H. Hewitt; remuneration of director appointed by first preference shareholders one guinea per board meeting attended; no remuneration for other directors except managing director. Registered office: 56, Paddington Street, W.

Jarrow and District Electric Traction Co., Ltd. (78,680).—This company was registered on September 30th, with a capital of £50,000 in £1 shares, to carry on in the United Kingdom and elsewhere the business of carriers of passengers and goods, electrical engineers, electricians, engineers, contractors, wharfingers, agents, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, mechanical and chemical engineers, generators, accumulators, transmitters, users and suppliers of light, heat, sound and power, by electricity, galvanism, magnetism, compressed air, gas, steam, oil, or otherwise, constructors, owners and workers of railways, tramways, slipways, or other ways or lines, &c. Possible agreements with the British Electric Traction Co., Ltd., are provided for in the articles of association. The first subscribers (each with one share) are:—E. Garcke, Donington House, Norfolk Street, W.C., managing director of British Electric Traction Co., Ltd.; W. L. Madgen, Victoria Works, Belvedere Road, S.E., electrical engineer; W. J. Greer, 58, South Katon Place, S.W., chairman of Tynemouth and District Electric and Traction Co., Ltd.; H. S. Day, 33, South Square, Westminster, company director; C. H. Dade, Donington House, Norfolk Street, W.C., secretary British Electric Traction Co., Ltd.; W. G. A. Bond, 47, Devonshire Street, Portland Place, W., director; and S. A. Sillers, Donington House, Norfolk Street, W.C., barrister. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, one share; remuneration, £50 each per annum and 5 per cent. of the dividend paid on ordinary shares divisible. C. H. Godward is the secretary. Registered office, Donington House, Norfolk Street, W.C.

Kinetic-Swanton Co., Ltd. (78,688).—This company was registered on October 1st, with a capital of £5,000, in £1 shares (4,000 6 per cent. cumulated preference), to acquire and carry on the business of electrical and general engineers, manufacturers of and dealers in electric, water and other engines and apparatus for blowing organs, manufacturers of air compressors and exhausters, importers, exporters, merchants, and commission agents, carried on by R. A. Cousans and L. B. Cousans, of Cathedral Street, Lincoln, as the Kinetic Blower Co., Lincoln, and by H. Swanton, of 62, Whitehorse Street, Stepney. The first subscribers (each with 1 ordinary share) are R. A. Cousans, Cathedral Street, Lincoln, engineer; L. B. Cousans, Cathedral Street, Lincoln, engineer; H. Swanton, 62, Whitehorse Street, Stepney, engineer; J. R. Cousans, Tendrum Road, Lincoln, organ builder; R. Starke, 195, Upper Thames Street, E.C., merchant; H. Mase, 45, London Road, King's Lynn, electrical engineer; and J. S. Dunstan, 62, Whitehorse Street, Stepney, E., engineer. No initial public issue. The number of directors is not to be less than 2 nor more than 5; the first are R. A. Cousans, L. B. Cousans and H. Swanton; qualification, 50 shares. L. B. Cousans and H. Swanton are managing directors, and may hold office for 18 years. Registered offices, Rosemary Lane, Lincoln.

ELECTRICITY SUPPLY ACCOUNTS.

Bury Municipal Electric Supply.

THE seventh annual report of the Bury Electrical Department indicates a steady improvement in the financial position of the undertaking, which has this year earned a net profit of £21, after two years with deficits. The contributing feature in this result is the improved load factor, and decreased works costs amounting to nearly ¼d. per unit. A great increase has occurred in power supply, amounting to 136 per cent. on the previous year, and as this improvement took place largely at the end of the year, the future prospects of this portion of the business appear very rosy.

We are indebted to the borough electrical engineer, Mr. S. J. Watson, for the following particulars as to the number and horse-power of motors connected:—

During year ending March,	1898	5	motors equal to	12	H.P.
" " "	1899	5	" "	14	"
" " "	1900	4	" "	14	"
" " "	1901	15	" "	58	"
" " "	1902	19	" "	89	"
" " "	1903	26	" "	270½	"
Total to March,	1903	74	" "	457½	"

The following table shows the total number and horse-power of the motors connected to the mains, together with the type of machinery driven, and illustrates clearly the appreciation which the small motor meets with in Bury:—

	Number.	H.P.
Bottling machinery	1	1
Dentistry	1	½
Engineering	10	103½
Fans	13	12
Hat works	5	23
Hay chopping and corn grinding	5	13
Hoists and lifts	8	40
Laundry machinery	1	8
Leather works	1	5
Mattress making	3	13
Mortar grinding	2	10
Organ blowing	1	1
Printing	6	38
Refrigerating and ice-making	5	86
Sewing machines	2	1½
Weaving	1	7
Woodworking	9	85½
Total	74	457½

The department contemplates the acquisition of a tramway load during the coming year, but the extra capital charges due to extensions of buildings and plant, will, in all probability, more than counterbalance any advantage due to the increased output for the next year or two.

The charges for energy are as follows:—Private lighting, on the maximum demand system, 6d. and 3d. per B. of T. unit, or a flat rate of 4½d. per unit; power, 3d. per unit for the first hour per day and 1d. after; public arc lamps, £17 10s. per annum, and incandescent lamps, £1 2s. 6d.

GENERAL STATEMENT.

For the year ending March—	1903.	1902.
Total capital expended	£59,240	£51,127
Number of units sold—		
Private lighting	220,002	202,310
Power	141,123	59,773
Public lighting	55,582	53,264
Technical school	8,286	7,990
Total	424,993	323,337
Equivalent number of 8-C.P. lamps connected	35,647	24,668
Number of public lamps	34 arc, 17 inc.	34 arc, 13 inc.
Number and H.P. of motors	74 = 458 H.P.	48 = 187 H.P.
Maximum load in KW.	319·7	273
Revenue account—		
Gross revenue	£6,060	£5,114
" expenditure	£2,981	£2,664
" profit	£3,079	£2,450
Average price obtained for private lighting	3·35d.	3·87d.
Average price obtained for public lighting	2·12d.	2·09d.

REVENUE ACCOUNT.

	Gross.	Per unit.
By sale of energy	£5,658	3·20d.
Meter and motor rents	397	·22d.
Sundries	5	·00d.
Gross revenue	£6,060	3·42d.

COST OF PRODUCTION.

For year ending March—	1903. Gross.	1903. Per unit.	1902. Per unit.	Inc.
Coal	£697	·59d.	·49d.	—·10d.
Oil, waste, water and engine-room stores	100	·06d.	·06d.	·00d.
Salaries and wages incurred in generation and distribution	623	·35d.	·41d.	—·06d.
Repairs and maintenance of buildings, plant, &c.	502	·29d.	·30d.	—·01d.
Works and distribution costs	£1,921	1·09d.	1·26d.	—·17d.
Rent, rates and taxes	391	·22d.	·22d.	·00d.
Management expenses, salaries of engineer and clerical staff	520	·29d.	·37d.	—·08d.
General expenses, printing, stationery, insurance, &c.	149	·08d.	·12d.	—·04d.
Total works cost	£2,981	1·68d.	1·97d.	—·29d.

A considerable reduction has been effected in works costs amounting to nearly ¼d. per unit; the majority of the items show improvement, the fuel item having benefitted by a reduction in cost price.

PROFIT STATEMENT.

Interest on loans	£1,382
Sinking fund	1,409
Net profit for year	21
Gross profit	£2,812

The year's working yielded a gross profit equivalent to 5½ per cent. on the average capital employed, compared with 5 per cent. in the previous year. This amount was allocated to interest and sinking fund charges, and the balance of £21 being net profit, is carried forward.

CITY NOTES.

Willans & Robinson, Ltd.

The report of the directors, to be submitted at the half-yearly meeting to be held at Victoria Works, Rugby, on Wednesday, October 14th, reads:—

"The accounts for the half-year ended June 30th, 1903, show that, after writing off as depreciation from plant, &c., the sum of £6,849 3s. 11d., and paying interest upon debenture stock, the balance to the credit of profit and loss account at the end of the half-year (including £1,374 19s. 11d. brought forward) is £24,227 12s. 8d. Out of this the directors propose that dividends be paid at the rate of 6 per cent. per annum upon the preference shares, and at 6 per cent. per annum upon the ordinary shares, amounting in all to £19,999 16s. The amount payable to directors, in accordance with the articles of association, and with the resolution of October 2nd, 1901, is £391 8s. 10d., leaving an available balance of £4,227 16s. 8d. From this the directors propose to carry £1,500 to the reserve fund, and to increase the amount carried forward by £1,352 16s. 9d., raising it to £2,727 16s. 8d. Certain important orders have lately been taken on the basis of payment being made, in part, in shares of the companies giving the orders, and a note referring to this appears upon the balance-sheet. The Queen's Ferry Works are still not in a position to earn profits for the company, but satisfactory progress has been made in overcoming the difficulties which have been met with. The gas engine business, to which allusion was made six months ago, promises to be very successful. A vertical gas engine of 375 I.H.P., which has lately been erected by the Corporation of Redditch, is working extremely well. The Corporation of St. Helens has placed an order with the company for a horizontal gas engine of 750 I.H.P., and two of about 1,000 I.H.P., each have been ordered for the electric light station at Reading. Two smaller vertical engines are also on order, and four other horizontal engines of about 300 I.H.P. each. It is believed that the patents which the company holds, combined with its reputation for good work, will ensure it a large business in gas engines."

Chilian Electric Tramway and Light Co.

The report for 1902 shows, after payment of interest accruing on advances for construction and other charges, a balance to debit of £3,626. From this amount is deducted the balance to the credit of profit and loss account carried forward from 1901, £3,301, leaving a net balance to debit of that account, to be carried forward, of £324. The net profits for the year 1902 on the operation of the tramways amounted to $271,058. During the first half of the year 1902, a net profit was made of $92,998; but during that time business generally was very depressed, owing, principally, to the strained relations existing with the Argentine Republic, and the constant fear of war between the two States. In September, 1902, business began to improve all round, and the net profit from the tramways from July 1st, 1902, to December 31st, 1902, amounted to $178,060. During the 12 months ended December 31st, 1902, the company carried 45,175,916 passengers, earning $2,003,487, as against 43,831,591 passengers, earning $1,965,660 for the preceding year. The reconstruction of the tramway to electric traction is now completed, with the exception of 2 to 3 kilometres. During 1902 the electric lighting department showed a total profit of $113,390, which has been carried to the profit and loss account. An amicable arrangement has been arrived at with the municipality of Santiago, and that Corporation is now gradually taking the company's light over an ever-increasing area of the city. Capital outlay has exceeded the authorised issue of capital and debentures, and the directors will have to bring forward proposals at an early date for increasing the capital to meet the necessary requirements of the undertaking.

Electrolytic Alkali Co.—The report states that the profit for the past year amounts to £483, which is carried forward. This result is largely accounted for by the conflict between foreign and English manufacturers of bleaching powder, which has occasioned great depression in prices.

Stock Exchange Notices.—The Committee has appointed special settling days as under:—Thursday, October 22nd: Underground Electric Railways Co., of London, Ltd.—Fully and partly paid provisional certificates for £3,599,268 5 per cent. profit-sharing secured notes. The Committee has also ordered the undermentioned securities to be quoted in the Official List:—Metropolitan District Railway Co.—£2,116,666 3 per cent. consolidated rent charge stock, in lieu (partly) of the 4½ per cent. Ealing rent charge stock and the 4½ per cent. Fulham rent charge stock now quoted.

Direct United States Cable Co.—Interim dividend, 3s. per share (at the rate of 3 per cent. per annum), for the quarter ending September 30th, 1903.

STOCKS AND SHARES.

Wednesday Evening.

After their slight rally at the end of last week, the Stock Exchange markets at first seemed inclined to relapse into an almost worse state than they were in before, but Mr. Chamberlain's speech had a good effect and another recovery has occurred. The support extended to Consols and those gilt-edged stocks which form the immediate satellites of Goschens has, however, not gone much further than that narrow circle, and timidity continues to play a leading part in the markets. Besides this disinclination of the public to take any hand in the generality of stocks and shares, there is still weakness in several of the speculative departments, and the flatness in the Kaffir circus has given rise to sales of investment shares elsewhere in order to raise money for the payment of differences and to maintain the margins upon loans from the banks. This influence has now spread to the electrical sections, which had so far almost escaped the infection of flatness that swept over the Stock Exchange during the latter half of September, and our price lists show a series of small declines amongst the supply shares, which latter usually enjoy firmness at times of depression elsewhere.

To particularise, there are eight falls in the electricity supply market against a solitary rise. At this season of the year an all-round improvement is fairly anticipated, the approach of winter serving to direct attention to those companies which stand to benefit by the drawing-in of the days. But although the returns to be derived even from the best class of shares in this market are high enough to warrant purchases, the buyers fail to put in an appearance. It is a daily complaint at the present time among City men that nobody has any money, and it is certain that those who have the capital, if there be any such, prefer to allow it to remain on deposit with the banks. Accordingly, a very slight pressure to sell has an effect quite unwarranted by its extent, and the few sales in the supply shares led to falls of 5s. in Brompton and Kensington Ordinary, both the Charing Cross and Strand issues, Chelsea Ordinary and London Electric Preference. In the last case the decline means the adjustment of the price to that at which it stood before last week's rise, and the improvement in South London Ordinary is the recovery of a recent fall. Westminster Ordinary are also a little weaker; the Stock Exchange Official List playfully quoted them at 13½ to 13½ the other day. St. James's Ordinary exhibit the heaviest drop, amounting to £1. The prior charges have not moved to any appreciable degree, Metropolitan 3½ per cent. Debenture providing the one quotable change, with a loss of a point.

No alteration in telegraph stocks has occurred on balance. American railroad shares have sustained a certain recovery from their lowest prices, and the Anglo-American telegraph group is, therefore, firm. "China" shares continue dullish at their reduced level of a week ago. The home railway market notices with interest that the London & Brighton Railway is about to introduce an experiment in wireless telegraphy on its system. Telegraph Trust descriptions keep idly steady. Direct United States Cable shares are to receive a dividend at the rate of 3 per cent. per annum.

While there is a somewhat better feeling amongst Home Railway stocks, it cannot be said that business shows much improvement. As regards the electrical lines, Central London and City and South London now have a traffic decrease in each case to contend with, as one result of the comparison with takings in the Coronation year, to say nothing of such drawbacks as the lowering of fares by competitors and the slight scare occasioned by the late mishaps on the "Twopenny Tube." The Ordinary stock of the latter company looks cheap enough to buy at its present reduced price, and in some quarters City and South London is advanced as a good speculative investment in view of the high return obtainable. Waterloo and City was done the other day at 94. Districts are 31½, and Metropolitan 81.

British Electric Traction of both kinds have receded ¼ upon sales by speculative holders, and there is a little business passing in Buenos Ayres and Belgrano Ordinary shares at about 2½. London United Tramway Debenture is still difficult to get at anything under the top price of 105, at which it changed hands on Tuesday. Other traction shares call for no particular comment, but amongst those which are less commonly dealt in it may be added that Calcutta shares are 7, Anglo-Argentines 4½, Barcelona 8, and Potteries 9½. The Preference shares of the last-named stand at 9, and the Debenture stock at 104½. New General Tractions are about 10s. and 2½ for Ordinary and Preference respectively.

Following the decline in Electricity Supply shares, Electric Constructions are ½ easier, while the Debenture came on offer, and shows a point fall, although General Electric Debenture is the same amount to the good. Willans & Robinson at 6 have been hardly affected by the issue of a report favouring the idea that the reduction in the dividend is due to causes which should prove to be but temporary. Babcock & Wilcox at 3 are now *ex* dividend, and the Preference keep about 30s.

National Telephone Deferred Stock and the Third Preference shares are both slightly lower, and the Preferred stock remains at par.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Sept. 30th.	Closing Quotations Oct. 7th.	Business done week ended Oct. 7th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛ — 3⅛	2⅛ — 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	6½s.	60/6	45 — 48	45 — 48	47½	..
3,105,880	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	91 — 93	92½	90½
3,105,880	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	7⅛ — 8	7⅛ — 8	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4⅛ — 5⅛	4⅛ — 5⅛	..	..
18,332,300$	Commercial Cable	$100	8 %	8 %	8 %	145 —155 xd	145 —155 xd	..	..
1,841,309	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93 xd	90 — 93 xd	93	91½
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16½ — 17½	16½ — 17½	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½ — 3⅛ xd	2½ — 3⅛ xd	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8 xd	7 — 8 xd	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —102 %	98 —102 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10½ — 10⅝	10½ — 10⅝	..	..
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	124 —129	126	125
1,955,565	Do. 5½ % Pref. Stock	100	..	..	..	90 — 93	90 — 93	91½	90
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	108	106½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11⅜ — 1½	11⅜ — 12½	12⅛	11⅞
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	105	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103 %	100 —103 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8⅜ — 9½	8⅜ — 9½	9⅛	8⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	12⅜ — 13⅜	12⅜ — 13⅜	13⅜	12⅞
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22½ — 23½	22½ — 23½	23⅜	23
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	37 — 40	37 — 40	37½	37½
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	98 —102	98 —102	..	..
1,988,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	99 —101	99 —101	100½	99½
1,966,667	Do. do. Def. Stock	100	..	..	4½%	75 — 77	74 — 76	76	74½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5⅛	4⅞ — 5⅛	5⅛	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 95	93 — 95	94½	93
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	103	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅞ — 1⅛	⅞ — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6⅛ — 7⅛	6⅛ — 7⅛	..	..
3,808	Submarine Cables Trust	Cert.	..	..	..	116 —121	116 —121	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5⅛ — 6	5⅛ — 6	5⅝	5⅛
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞ — 5⅛	4⅞ — 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 267,980	10	7 %	7 %	..	12 — 12⅛	12 — 12⅛	12⅛	12⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	99⅜	99
88,821	West India and Panama Telegraph	10	1½%	..	..	⅞ — ⅞	⅞ — ⅞	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6⅛	6 — 6⅛	6⅛	6⅛
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3½ — 4½	3½ — 4½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	98 —101	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	83 — 87	83 — 87	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	12½ — 13	12½ — 12¾	12¾	12 7/16
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11⅝ — 12	11⅝ — 12	11⅝	11 7/16
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —123 xd	122 —125	120½	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6½ — 7	6½ — 7	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5½ — 5⅝	5½ — 5⅝	5 5/16	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —106	102 —106	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	0 — ⅛	0 — ⅛	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾ — 1	¾ — 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1 — 1⅛	1 — 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
85,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11¼ — 12½	11¼ — 12½	11¼	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¼ — 5⅜	5¼ — 5⅜	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	94 — 97	94 — 97	96	95
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	99 —102	99 —102	..	..
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	99 —102	99 —102	100½	..
1,880,000	City and South London Railway	Stock	1½%	2 %	3½%	56 — 58	56 — 58	57½	56
85,000	Crompton & Co., Nos. 1 to 85,000	5	8 %	7½%	5 %	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	100 —104	100 —104	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1½ — 2½	1½ — 2½	..	..
844,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81 xd	76 — 81 xd	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅜ — 1⅝	1½ — 1⅝	1½	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2¼ — 3	2½ — 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	98 —101	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½ — 10	9½ — 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	96 — 99 xd	97 —100 xd	..	..
85,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	14⅜	14¼
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛	5 — 5⅛	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	10 %	18½ — 19½	18½ — 19½	19	18½
800,000£	Do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	4⅞ — 5⅛	4⅞ — 5	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½ — 11	10½ — 10⅞	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	34 — 37	34 — 37	34	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
640,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3⅛%	93 — 96	93 — 96	94	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring ⅛—⅜.

Oldham, Ashton and Hyde Electric (£10 pd.), Ord., 14½—14⅝.
Do. do. Pref. £10 pd.), 10—10⅛.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Sept. 30th.	Closing Quotations Oct. 7th.	Business done week ended Oct. 7th, 1903. Highest	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡ 1	..	..	..	⅝ — ¾	⅝ — ¾	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	116 —119 xd	116 —119 xd	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10¼— 11¼	10¼— 11	10⅝	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼— 10⅝	10¼— 10⅝	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9½	8¾— 9¼	9⅛	8 13/16
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5¾— 6	5¼— 5⅝	5⅝	5⅜
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅝— 5	4⅜— 5	4 13/16	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	..	..
44,436	*Chelsea Electricity Supply, Ord.	5	5¼%	4 %	4½%	5⅝— 6⅛xd	5⅝— 6	5⅝	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10¼— 11	10¼— 11	10 11/16	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7⅞— 8½	7⅞— 8½	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11¾— 12¼	11¾— 12¼	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	109 —112	109 —112	107½	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —104	..	102½	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6½— 7	6½— 7	6⅞	6 11/16
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6¾— 6⅞	6¾— 6⅞	6 7/16	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —109	106 —109	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10¾— 11¼	10¾— 11¼	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	101 —104 xd	101 —104 xd	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞— 2⅛	1⅞— 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅜— 6	5¼— 5⅝	5⅛	5 1/16
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —102	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6¼%	7½%	17½— 18½	17½— 18½	18¼	17⅞
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	3⅝— 3⅞	..	3¾	3⅝
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —114	110 —114	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101 xd	97 —100	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	13 — 14	13	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15½— 16⅝	14½— 15½	15	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3½	5 — 3½	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¾%	3⅜— 4	3⅜— 4¼	3 15/16	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4⅜— 5⅛xd	4⅜— 5⅛xd	5	4⅞
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4¾— 5 xd	4¾— 5 xd	4 15/16	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	13 — 14	12½— 13½	13⅜	13⅛
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6½	6⅛	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, October 7th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£20	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	8d.	..
a ,, Caustic (75/80%).. ..	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	188/-	8s. inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda. Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks.. ..	per lb.	2½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £135	..
c Brass (rolled metal 2" to 12") basis	per lb.	7d.	..
c ,, Tube (brazed)	per lb.	8¾d	..
c ,, ,, (solid drawn).. ..	per lb.	7¾d.	..
c ,, Wire, basis..	per lb.	7¼d.	..
c Copper Tubes (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn) ..	per lb.	9¼d.	..
g Copper Bars (best selected ..	per ton	£71	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£71	..
g ,, Rod	per ton	£71	..
e ,, (Electrolytic) Bars ..	per ton	£65	£2 dec.
e ,, ,, Sheets ..	per ton	£75	£2 dec.
e ,, ,, Rod ..	per ton	£67	£2 dec.
e ,, ,, H.C. Wire	per lb.	8d.	¼d. dec.
f Ebonite Rod	per lb.	3/8	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/4½ to 4/7½	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	45/1½	..
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 10	5/- inc.
g ,, ,, Sheet	per ton	£13	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 7 6	..
d Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d ,, ,, ,, medium	per lb.	2/6 to 3/9	..
d ,, ,, ,, large ..	per lb.	4/- to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£118 to £118 10	dec.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/6	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4 13/16d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 5	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

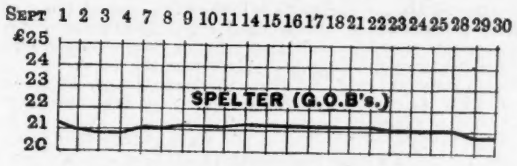
	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Oct. 3	1,806	+309	23,730	+ 3,273	10	—
	Birmingham	,, 3	5,476	+366	203,321	+ 9,031	—	—
	Bournemouth	Sep. 30	1,120	—	—	—	10½	—
	Blackburn	—	—	—	—	—	12½	+1½
	Blackpool	Oct. 1	1,120	+ 34	33,271	— 116	8½	—
	Blackpool and Fleetwood	,, 3	762	+ 95	17,975	— 113	7½	—
	Bolton	,, 4	1,872	+325	51,175	+ 6,725	25	—
	Bradford	—	—	—	—	—	41	+4
	Brighton	,, 4	948	+189	40,119	—	6½	—
	Bristol	,, 2	5,220	+608	—	—	28	—
	Burnley	,, 3	889	+146	—	—	7½	—
British Elec. Trac. Co.	Barnsley District ..	Sep. 25	184	—	6,975	—	4½	—
	Devonport	,, 25	523	+ 60	17,407	+ 596	5	—
	Dudley—Stourbridge..	,, 25	983	+ 92	32,423	+ 8,170	18½	—
	Gateshead	,, 25	899	+ 7	33,273	+ 4 617	10½	+ ¾
	Gravesend—Northfleet	,, 25	306	+ 68	9,334	+ 781	3½	—
	Greenock—Pt. Glasgow	,, 25	546	+ 54	21,162	+ 1,639	7½	—
	Hartlepool	,, 25	302	+ 26	10,401	+ 436	6½	+2
	Kidderminster	,, 25	151	+ 2	5,102	+ 184	4½	—
	Merthyr	,, 25	213	— 16	7,641	— 228	3	—
	Middleton	,, 25	309	+ 65	12,689	+ 1,565	8½	—
	Oldham—Ashton ..	,, 25	592	+ 21	22,095	+ 1,498	8	—
	Peterborough	,, 25	151	—	5,705	—	—	—
	Poole	,, 25	358	+ 43	12,020	+ 1,799	3½	—
	Potteries	,, 25	1,800	+185	59,980	+ 3,307	20	—
	Rothesay..	,, 25	126	+ 8	6,298	+ 1,613	2½	—
	Sheerness	,, 28	79	—	2,816	—	2½	—
	Southport	,, 25	351	+ 57	12,881	+ 2,909	6½	—

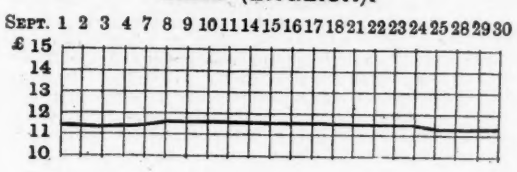
* Compared with the corresponding period of 1902.

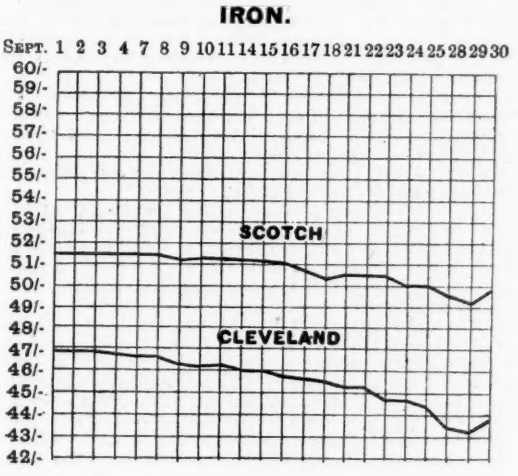
	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open. *
B.E.T. Co.	South Staffordshire ..	Sep. 25	1,067	+ 306	34,513	+ 4,965	21½ — ¾
	Swansea	,, 25	541	+ 28	20,163	+ 1,680	5½ —
	Taunton	,, 25	66	— 2	2,383	— 223	1½ +1½
	Tynemouth	,, 25	322	— 45	12,688	+ 887	3½ —
	Weston-super-Mare..	,, 23	163	— 1	5,191	— 458	2½ +2½
	Wolverhampton Dist.	,, 25	395	+ 79	15,140	+ 7,113	10½ +8
	Wrexham	,, 25	176	—	3,689	—	— —
	Yorks. Woollen Dist..	,, 25	498	—	11,248	—	6 —
	Cardiff	,, 26	2 004	+398	52,260	+15,475	14 —
	Chatham & District Co.	,, 24	617	+ 22	20,511	+12,709	8·53 —
	Dover	Oct. 3	319	+ 39	9,092	+ 98	3 —
	Dublin	,, 2	5,107	+518	76,708	+ 6,934	46½ + ½
	East Ham	,, 3	690	+ 205	18,907	+ 5,783	5 + ¼
	Glasgow	,, 3	15,667	+ 2180	246,354	+27,330	66 + 9
	Hull	,, 3	1,906	+147	49,616	+ 2,495	11 + 1
	Ilkeston	Sep. 30	182	—	—	—	4 —
	Isle of Thanet	Oct. 3	632	+ 88	29,552	— 1,476	10½ —
	Leeds	,, 3	6,099	+989	154,043	+ 9,482	41 —
	Liverpool	Sep. 26	11,072	+ 599	392,589	+12,542	108 —
	Manchester	Oct. 3	12,137	+ 6691	320,875	+198,348	72 —
	Newcastle	,, 3	3,680	+ 655	—	—	17 —
	Portsmouth	,, 3	1,691	+ 369	—	—	29 —
	Salford	—	—	—	—	—	30 —
	Southampton	,, 1	1,099	+ 16	—	—	9 —
	Sunderland	,, 4	1,918	+172	95,167	+ 1,835	20 +3
	Central London Railway	,, 3	5,183	—719	84,636	— 4,202	6 —
	City and S. London Ry.	,, 4	2 544	— 489	34,574	— 4,702	5½ —
	Dublin and Lucan Elwy.	,, 4	144	+ 42	2,043	+ 151	6½ —
	Liverpool Overhead Ry.	,, 4	1,673	+166	23.977	+ 1,667	6 —

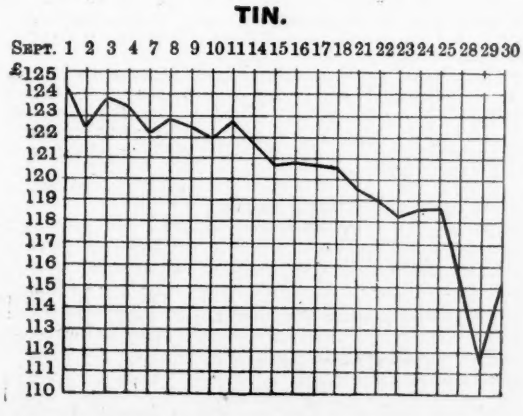
METAL MARKET.

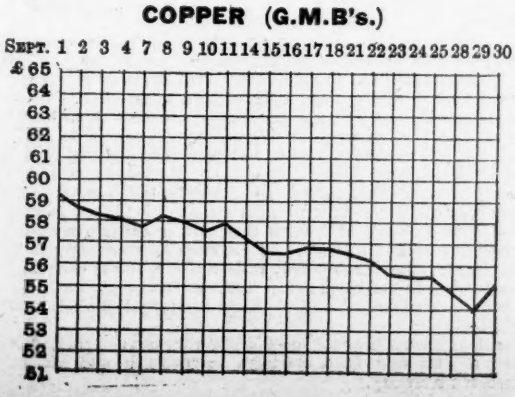
Fluctuations in September.











THE BRITISH ASSOCIATION, SOUTHPORT, 1903.

EXPERIMENTS FOR IMPROVING THE CONSTRUCTION OF PRACTICAL STANDARDS FOR ELECTRICAL MEASUREMENTS.

Report of the Committee, consisting of Lord Rayleigh (*Chairman*), Dr. R. T. Glazebrook (*Secretary*), Lord Kelvin, Profs. W. E. Ayrton, J. Perry, W. G. Adams, *and* G. Carey Foster, Sir Oliver J. Lodge, Dr. A. Muirhead, Sir W. H. Preece, Profs. J. D. Everett, A. Schuster, J. A. Fleming, *and* J. J. Thomson, Dr. W. N. Shaw, Dr. J. T. Bottomley, Rev. T. C. Fitzpatrick, Dr. G. Johnstone Stoney, Prof. S. P. Thompson, Mr. J. Rennie, Dr. E. H. Griffiths, Sir A. W. Rucker, Prof. H. L. Callendar, *and* Mr. George Matthey.

(*Read before Section A.*)

During the year a very complete comparison of the resistance standards belonging to the Association has been carried out, and the standards have been compared with those of the Reichsanstalt and of the Board of Trade.

The various units discussed in the report are: (1) The "ohm," 10^9 C.G.S. units of resistance; (2) the international ohm—viz., the resistance at 0° C. of a column of mercury of uniform section 106·3 cm. in length and 14·4521 grammes in mass; (3) the original B.A. unit; (4) the Board of Trade unit, supposed to represent the international ohm, but constructed in 1891 so as to be equal to 1·0358 B.A. units; (5) the N.P.L. unit defined as No. 4, as deduced from the wire standards of the Association; (6) the Reichsanstalt unit, constructed at the Reichsanstalt to represent the international ohm; (7) the mercury tubes, constructed at the National Physical Laboratory to represent the international ohm.

A full account of this comparison is given in Appendix I. to the report, by Mr. F. E. Smith, of the National Physical Laboratory. It appears from this that changes have shown themselves in all the original platinum-silver coils. The relative values of these coils are discussed in the reports of the Committee for 1888, 1890 and 1892. The 1888 report contains a very complete comparison of all the coils, not merely those of platinum-silver; and it is there shown that they then agreed with the values assigned to them by Fleming in 1881. The conclusion is also drawn in the same report that, with the exception of the platinum-iridium coils A and B, no really certain variations could be traced in the other coils between the results of Matthiessen and Hockins's comparisons in 1864 and 1867, those of Chrystal in 1876, Fleming in 1881, and the present secretary * in 1888. A postscript to the Report for 1888 recorded, however, an appreciable change in the coil F in the autumn of that year.

In Appendix I. Mr. Smith starts with the values given in the 1888 Report, which are, as nearly as we can tell, the original values of the coils.

Changes in the three standards F, G, H have already been recorded in previous Reports (1890 and 1892). The standard coil Flat remained unchanged in value until 1901-1902. Between the observations recorded in these years it increased in resistance by 17×10^{-6} B.A.U., and has not varied since.

The alterations in the other coils since the comparisons in 1888 have been as follows:—

F. $+ 97 \times 10^{-5}$ B.A.U.
G. $+ 33 \times 10^{-5}$ „
H. $+ 18 \times 10^{-5}$ „

It should, however, be noted that, while between 1888 and 1890 the change in F was $+ 64 \times 10^{-5}$ B.A.U., that in G was $- 27 \times 10^{-5}$, and in H $- 13 \times 10^{-5}$. Since 1890 the same coils changed by $+ 33 \times 10^{-5}$, $+ 54 \times 10^{-5}$, and $+ 31 \times 10^{-5}$ B.A.U. respectively, while between 1901 and 1902 Flat, as has already been stated, rose by 17×10^{-5} B.A.U.

It is not easy to trace the causes of these changes. In the case of Flat the observations in 1901 were made at Kew, those in 1902 at Bushey House, and the change may in some way be connected with the removal of the coils. The changes in F, G, H first showed themselves after the coils had been subject to a very low temperature, and may have been started by strains due to this.

Appendix I. gives the details on which these various statements are based. It appears also from the same Appendix that the new platinum-silver ohm standards of the Association have retained their values since 1898 practically unchanged.

The comparison between the standards of the Association and those of the Reichsanstalt leads to the result that the unit of the Association (No. 5 of those defined above) is less than that of the Reichsanstalt (No. 6) by ·00105 ohm. This result is deduced (Table IX. of Appendix I.) from a series of extremely concordant measures on coils of value 0·1, 1, 10, 100, 1,000, and 10,000 ohms; thus both the unit and the multiple coils agree in giving the same difference between the Reichsanstalt and ourselves.

By the kindness of Mr. Trotter a comparison has been made between the Board of Trade unit and those of the Association, with the result that, as deduced from the unit coils, the Board of Trade unit is less than that of the Association by ·00006 ohm. This result, however, is not confirmed by a comparison of a 1,000-ohm coil belonging to the Association with one of those of the Board of Trade†; these coils show no difference.

The above statements are made on the assumption that the various

* It is possible that coil F is an exception to this statement.

† If the view be accepted that the laboratory unit is the same as in 1891, the Board of Trade standard has fallen since that date by ·00006 ohm.

changes in the coils which have undoubtedly occurred have been rightly interpreted, so that we can now recover the absolute C.G.S. value of the coil Flat, and hence of the standard ohm as originally determined at the Cavendish Laboratory, and defined by the Committee in the Edinburgh Report, 1892.

That this is the case is borne out by the results of the experiments on the specific resistance of mercury, a summary of which is given in Appendix II. These are not yet complete. Mr. Smith has, however, constructed and calibrated 11 mercury tubes. The mean cross-section of each of these has been determined by at least four different sets of measurements. In nine cases the greatest difference between any measurement and the mean is not more than ·001 per cent.

The values found for the resistance of each tube do not differ by more than ·001 per cent.

If we assume, as above, that the values of the wire standards of resistance of the Association are known in terms of the absolute C.G.S. unit, then it follows that the length of the column of mercury, 1 square millimetre in section, which would have a resistance of 10^9 C.G.S. units, would be 106·291 centimetres. The value found for this same quantity by the secretary (Mr. Glazebrook) and Mr. Fitzpatrick in 1888* was 106·29 centimetres. We infer, then, that we still can recover from our standard coils the absolute C.G.S. unit of resistance.

Again, the length of the mercury column consituting the international ohm has been defined as 106·3 cm.

But we have seen that the absolute C.G.S. unit as deduced from the wire coils of the Association has a resistance equal to that of 106·291 cm. Thus the absolute unit† is smaller than the international ohm by ·009 per cent. Again, it has been stated above that the unit deduced from the standards of the Association is smaller than that of the Reichsanstalt by ·0105 per cent.

Thus the mercury standards of the Reichsanstalt, constructed to represent the international ohm, exceed those just made for the Association by Mr. Smith by ·0015 per cent, or 1·5 parts in 100,000.

Again, if these results be accepted, since the Board of Trade unit as derived from the wire standards is less than that of the Association by ·006 per cent., and the Association unit is too small by ·009 per cent., it follows that the Board of Trade unit is too small by ·015 per cent. This difference arises in part from the fact that the standards of the Association, from which the Board of Trade standard was copied by the secretary in 1891, are too low; in part from the fact that the Board of Trade standard has diverged slightly from that of the Association since 1891.

Thus, to sum up this part of the Report, it may be stated that:—

(*a*) The original B.A. unit and the standard ohm based on it (Nos. 3 and 5 of the units concerned) can be recovered from the wire coils of the Association.

(*b*) The Board of Trade unit (No. 4) is now less than the laboratory unit (No. 5) by ·006 per cent.

(*c*) The laboratory unit (No. 5) is less than the international ohm (No. 2) by ·009 per cent.

(*d*) The Board of Trade unit is less than the international ohm by ·015 per cent.

(*e*) The mercury tubes made at the National Physical Laboratory to represent the international ohm are less than those made at the Reichsanstalt by ·0015 per cent.

This last result must be considered as provisional pending the completion of Mr. Smith's work, but it is clearly highly satisfactory.

Mr. Smith has also made progress during the year with his investigations into certain of the anomalies shown by Clark cells, but the results of that inquiry are not yet ready for publication.

The standard condensers of the Association have been frequently in use during the year; about 15 condensers have been compared with them. They retain their value in a satisfactory manner, and are convenient to work with, though possibly some improvement in the insulation might be desirable.

A chronograph, purchased with part of the grant made last year, will enable the time measurements required in the measurement of capacity to be made with greater accuracy, and hence will permit of greater rigidity in the inquiry as to the permanence of the standards.

The platinum thermometers made from the stock of wire purchased from Messrs. Johnson & Matthey, which at the time of the last report were in course of construction, have been completed, and the behaviour of some of them investigated throughout the past year. The resistance box available was the old Callendar-Griffiths box used in the work of Dr. Chree at Kew Observatory, having coils of platinum-silver on the binary system. The contacts are an old form of the Cambridge Instrument Co.'s type of plug contact, the cheeks being made of a special white alloy held in round Doulton-ware cups. In measurements with this box not much significance attaches to the third figure of decimals representing hundred-thousandths of an ohm, though the settings could be made to this amount at the lower temperatures. The box resistance-coils were intended for use with platinum thermometers of 1 ohm fundamental interval only, and therefore the two high-resistance thermometers, of 5 ohms fundamental interval, could not be measured at the sulphur-point; their systematic investigation has therefore been temporarily postponed. The want of a better box for this work is seriously felt.

Of the original six thermometers made in August, 1902, Nos. 1 to 4 are of 1 ohm fundamental interval, Nos. 1 and 2 being in porcelain and 3 and 4 in specially thin Jena glass tubes of internal diameter 8 to 9 mm. and 38 to 40 cm. long. Nos. 5 and 6 are of 5 ohms fundamental interval, and in somewhat wider tubes of specially thin glass, through which the four leads are hermetically sealed. The heads of all these thermometers are of the design used by Chappuis and Harker, the contacts to the solid ends of the copper flexibles being made by fusible metal cups. With reasonable care these contacts prove very satisfactory, both as regards the constancy of their resistance and their mechanical strength.

In the construction of all these thermometers special care was devoted to adjusting their fundamental intervals to be very close to their nominal values, and after completing this adjustment all were subjected to repeated annealing in air at a bright-red heat, thermometers Nos. 3 and 4 being temporarily placed in porcelain tubes for the purpose.

The remaining four constructed last summer, and one of later date, all of 1 ohm fundamental interval, have had their constants determined from time to time during the year. One of them—B.A. 2—was selected as a representative platinum thermometer for use in an investigation made to determine the relation between the platinum scale and that of the gas thermometer of the National Physical Laboratory at temperatures up to 1,000° C. During the time occupied by two sets of experiments with this instrument, extending over about three months in all, its constants altered by an amount only just greater than their probable error, showing that it is quite possible to use properly constructed platinum thermometers up to temperatures slightly over 1,000° C. for long periods without fear of serious changes.

The summary of the life history of the different thermometers is given in Appendix III. The chief fact apparent is that there seems to be a small but real difference between the δ of thermometers 1 and 3 on the one hand, and 2, 4, and 7 on the other, the maximum divergence being about ·02.

Prolonged electrical heating in air of the wire of one of the thermometers was not found to sensibly change the value of the δ. The cause of the small differences found is not obvious, and further investigation is being made on this point.

A change in δ from 1·50 to 1·51 would make at the sulphur point a difference of 0·153° C., and at 1,000° C. one of 0·9°.

The question of the resistance of copper has been raised lately by the work of one of the sub-committees of the Engineering Standards Committee. For commercial purposes, the resistance of copper is defined at a temperature of 60° F. (15·55° C.). A table in Appendix IV. gives the values that have been found by various experimenters.

It is clear that copper is now prepared of a higher degree of purity than in the time of Matthiessen. Taking the mean of the figures in the table for modern electrolytic copper, we have, as the value of the resistance of 1 metre of copper wire weighing 1 gramme at 15·55° C. the value $0{\cdot}1485_5$ ohm, but the figures of which this is a mean range from 1475 to 1492. The value found by Matthiessen, as deduced from his paper in the *Phil. Trans.* for 1860, is 0·1500 ohm. Thus the conductivity of modern pure electrolytic copper is 1 per cent. better than Matthiessen's.

The Committee on copper conductors, which investigated the question in 1899, adopted the number 0·1508 ohm as the resistance of a metre-gramme of commercial annealed high-conductivity copper. This figure has been accepted by the Engineering Standards Committee.

Mr. H. A. Taylor has recently placed in the hands of the Secretary two resistances of gold-silver wire made by Matthiessen himself, to represent the resistance at 15·5 C. of 100 in. of pure annealed copper, having the weight of 100 grains. The resistances of these coils have been determined by Mr. Smith, and the results are given in the following table:—

	Coil No. 1.	Coil No. 2.
Resistance of 100 in. of copper weighing 100 grains, as given by Matthiessen in B.A. units at 15·5° C.	·1516	·1514
Resistance found in 1903 in B.A. units at 15·5° C.	$·1513_5$	$·1513_2$
Resistance found reduced to ohms at 15·5° C.	$·1493_2$	$·1492_9$
Resistance deduced of a metre-gramme in ohms at 15·5° C.	$·1499_6$	$·1499_4$

Thus Matthiessen's value for the resistance of annealed copper at 15·55° C. (60° F.) as deduced from these coils, agrees very closely with the value calculated by the secretary from the figures in his 1860 paper.

The Committee have had under consideration the drawings and specifications for the ampere balance as designed by the late Principal Viriamu Jones and Prof. Ayrton. The electrical parts of the instrument need construction under skilled supervision. Tests of various kinds have to be made continually, and the Committee have come to the conclusion that this supervision can best be secured by having the instrument constructed in the workshop of the National Physical Laboratory, under the care of Prof. Ayrton and the secretary, who, as director, will be able, with the assistance of the staff of the Laboratory, to control the work in an efficient manner.

The Committee are of opinion that further expenditure will be required in completing the set of platinum thermometers, in particular in providing a satisfactory resistance-box and in carrying out the researches on the Clark cell. They consider that it is of great importance that these researches should be brought to a satisfactory conclusion.

For these reasons they recommend that they be re-appointed, with a grant of £60, that Lord Rayleigh be chairman, and Mr. R. T. Glazebrook secretary.

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* *Phil. Trans.* 1888.

† The resistance taken for a column of mercury 1 sq. mm. in section, 100 cm. in length at 0° C. at the Edinburgh meeting in 1892, was $·9407 \times 10^9$ C.G.S. units. Mr. Smith's experiments give, assuming the values of the wire coils known, the result $·9408 \times 10^9$ C.G.S. units.

APPENDIX I.

On the Values of the Resistance of Certain Standard Coils of the British Association. By F. E. Smith.

(From the National Physical Laboratory)

[The Report covers the period 1888—1903 inclusive.]

Changes of very considerable magnitude have taken place since 1892 in the old B.A standards. The removal of the coils, first to Liverpool, then to Kew, and finally to Teddington, has resulted in the comparisons being incomplete in some years. In consequence, the difficulty of locating differences has correspondingly increased.

The observations recorded are in terms of B.A. Flat. Owing to a change in Flat taking place, however, the 1903 comparisons were made chiefly with Nalder 3,715.

In Table I. the approximate difference in B.A.U. between Flat and the B.A. units coils F, G, H of the Association are given.

Table II. gives the difference in ohms between* (1·01358 × Flat) and other platinum-silver coils. Temperature of observations, 16° C.

Table I.

Year.	Flat.		
	F	G	H
1888	$+47\times10^{-5}$	$+91\times10^{-5}$	$+77\times10^{-5}$
1890	−17	+112	+90
1891	—	—	—
1892	−18	+108	+92
1894	—	—	—
1897	—	—	—
1898	−36	+99	+69
1900	−47	+92	+63
1901	−42	+92	+70
1902	−38	+90	+76
1903	−38	+75	+76

Table II.

Year.	(1·01358 × Flat.)			
	Nalder 3,715	Elliott 264	Elliott 269	Elliott 270
1888	—	—	—	—
1890	—	—	—	—
1891	—	$+13\times10^{-5}$	—	—
1892	—	—	—	—
1894	-17×10^{-5}	—	-37×10^{-5}	$+27\times10^{-5}$
1897	—	—	—	—
1898	−17	+9	−46	+27
1900	−17	+23	−59	+27
1901	−17	+23	−54	+27
1902	0	+38	−39	+44
1903	0	—	−39	+44

Table III. shows the percentage difference between (1·01358 × Flat) and the unit of two 10-ohm platinum-silver coils of the Association at 16° C.

Table III.

Year.	(1·01358 × Flat.)	
	Elliott 288.	Elliott 289.
1897	-27×10^{-5}	$+7\times10^{-5}$
1898	−27	+7
1902-3	−10	+24

The coils F, G and H are similarly constituted: they are the old B.A. coils made by Matthiessen. No. 3,715 is by Nalder Bros., and the remainder of the coils by Messrs. Elliott Bros. No. 264 is a coil belonging to the Board of Trade, and has been returned to Whitehall; hence there are no observations for 1903.

Tables I., II. and III. assume Flat to be constant. It will be observed that the differences of Flat and 3,715, 270, 288 and 289 are constant from 1897 to 1901. From 1901 to 1903 a change of about ·017 per cent. is evident between Flat and the coils 3,715, 264, 269, 270, and again between Flat and the units of the coils 288 and 289. This suggests a change in the value of Flat from 1901.

(To be continued.)

THE PARALLEL WORKING OF ALTERNATORS.

By B. Hopkinson.

(Abstract of Paper read before Section G, September 14th.)

In this paper I attempt to co-ordinate the mathematical treatment of the subject with the practical rules which have been framed, and which are now regarded as good standard practice, and to point out the reason for certain phenomena which have been observed.

Dynamically, the question of the parallel working of alternators, or the running of a synchronous motor or converter, is a problem of oscillation about a state of steady motion. Consider an alternating dynamo connected to a source of supply of constant amplitude and periodicity, and driven by a constant power or working against a constant resistance. For simplicity of expression we may suppose that the dynamo, and the generators giving the supply, have all the same number of poles. Then the dynamo will run with the same angular velocity as the supply generators, but with a certain difference of phase dependent on its excitation and on its load or driving power. This is the state of steady motion. If that state be disturbed—say by temporarily varying the load on the dynamo if working as a motor—the dynamo will make oscillations about it, sometimes running ahead of, and sometimes lagging behind the position of steady motion. When ahead of that position it will take less, and when behind it will take more, than its proper supply of energy from the mains.

The practical problem is to keep these oscillations, with their accompanying fluctuations, in the flow of energy to or from the mains or bus-bars, within moderate limits.

The oscillations may be either free or forced. To clear the ideas we may consider the case of a dynamo working as a synchronous motor, but the results are immediately applicable to the case of a generator. Suppose that the load on the motor is slightly increased. The motor will take up a position in which the phase difference between it and the generators is rather greater than before. The torque developed by the motor increases. If now the additional load be removed, there will be a balance of torque of that amount available for accelerating the motor, which accordingly will proceed to catch up, so to speak, the state of steady motion. After a time it will arrive at the position of steady motion, but will then be moving with more than the steady motion velocity. In consequence of the difference of velocity, the motor will not exert quite the steady motion torque, but there will be a balance of torque tending to accelerate it or retard it. This, if the difference in velocity is small, will be proportional to that difference.

The oscillations thus produced are the free oscillations executed by the dynamo when disturbed by a temporary change of conditions—*e.g.*, if its load be suddenly thrown off, or if, being a generator, it be switched into parallel with its fellows.

It is obvious that the importance or otherwise of these free oscillations depends on whether they are damped out or not. It has usually been assumed that the oscillations are resisted by a sort of viscous force, and if that is so the oscillations will of course, rapidly disappear. I have, however, recently shown that under certain circumstances the oscillations will continually increase in amplitude and the running of the dynamo will be unstable.

Suppose that the dynamo is working as a generator and is driven by a force with a certain periodic variation—*e.g.*, by a reciprocating engine. It is supposed to be coupled in parallel with such a number of other machines that the bus-bar potential is practically constant.

Then forced oscillations are produced by uneven turning moment in the prime mover. Superposed on them there will be the free oscillations already considered.

The possibility of parallel working, or of the working of a synchronous motor, therefore depends on two conditions. First, any free oscillations must be damped out within a short time of being set up. Second, the forced oscillations must be of such moderate amplitude as not to interfere with practical working. I will deal first with the last-named condition, as it admits of much simpler treatment than the other.

For an ideal machine, without any flywheel effect at all, the phase displacement is always such as to correspond exactly with the torque exerted by the prime mover. Such a machine would run fairly well in parallel with others, simply delivering to the bus-bars at all times exactly the energy given to it by its engine. But now if a flywheel be added, so long as the natural period of the alternator is less than that of the variation in turning moment, the amplitude of the oscillations becomes greater with increase of fly-wheel effect until there is perfect resonance, and the oscillations are only restrained by the viscous damping. Further increase in the flywheel effect results in a continuous diminution of the oscillations.

Now, the practical rule always adopted by designers for working in parallel is that the angular displacement of the machine in a revolution when running unloaded as compared with a uniformly revolving wheel shall not exceed a certain fraction (varying from $\frac{1}{110}$ to $\frac{1}{70}$) of the angular pitch of the poles. The practical rule, therefore, directly limits the angular amount of the forced oscillations, provided that the natural period of oscillation of the alternator is large compared with the period of variation in turning moment.

Limitation of the angle by which the machine deviates from perfectly uniform rotation is not, however, precisely what is needed. What should be limited is rather the amount of the fluctuation in the rate at which energy is delivered by the machine to the bus-bars. This, since the speed is practically constant, is proportional to the variation of torque, and depends upon the electrical properties of the machine, and is inversely proportional to the square root of its self-induction. Hence a machine with small self-induction will operate worse in parallel under a given amount of angular displacement than will another of large self-induction, always supposing the above-mentioned condition of long natural period to be fulfilled. Here, therefore, is a sufficient explanation of the wide variation in angular deviation permitted by different designers; what suits one machine will not suit another, and a machine with small self-induction and armature reaction, or what is called a machine with good inherent regulation, must be subject to more stringent rules as regards angular deviation than one with large self-induction.

Another cause which makes a fixed rule as to angular deviation inapplicable to all cases, is the fact that in some designs the natural period of oscillation may not be long, compared with the period of the engine impulses. Should these two periods become even approximately equal, the rule quite ceases to be applicable, and the amount of angular deviation in actual working as a generator bears no fixed relation to, but is much greater than, the same deviation when unloaded. As a matter of fact, in machines as now designed, in which the self-induction and armature reaction are usually sufficient to allow the machine to be short-circuited when partially excited without damage, the natural period of oscillation, even without a flywheel, is usually greater than the period of engine impulse. The latter period, even in a slow speed engine, will not, as a rule, exceed one-third of a second, while the natural period will be found to be of the order of half a second or more, and very much greater with a heavy fly-wheel. Probably, therefore, a designer will generally be justified in assuming that the two periods are sufficiently different to ensure that he will get about the same angular deviation when delivering energy to the bus-bars as when the machine is running disconnected. He will, however, have to take account of the change in the rate of flow of energy to which that deviation corresponds on his particular machine, and it is in neglecting that factor that the practical rule seems to be illogical.

We have, so far, considered that particular component of variation in turning moment which is responsible for the major part of the

* 1 B.O.T. ohm = 1·01358 B.A.U.

phase displacement when the machine is running disconnected, and which is, accordingly, alone regarded in the practical rule for flywheel effect. That, however, is not in fact the only component of the variations; there will be other components of both longer and shorter period. Take, for example, the case of a single-cylinder double-acting Körting gas engine running at 90 revolutions. The principal variation in turning moment, and the only one producing any appreciable effect on the phase displacement when running light, will be due to the explosions, and will have a period of one-third of a second. As stated above, the natural period of oscillation of the alternator will probably be much greater than this. But there will also be a variation in turning moment due to the weight of the crank, with a period the same as that of the revolution of the engine, or two-thirds of a second. Now, it is not impossible, with a light flywheel, for the period of oscillation of the alternator to have that value, and, if that were so, violent hunting would be set up, even though the variation in turning moment due to this cause were too small to produce an appreciable effect on the phase displacement when running light. Only, in this case of a small disturbing force, the approximation of periods must be fairly close to produce serious effects. The ordinary rules as to flywheel effect generally result in the natural period of oscillation being substantially greater than the period of revolution of the engine, but in a somewhat roundabout and accidental way. In seems highly desirable on many grounds to pay more attention than has hitherto been usual to the natural period of oscillation of the alternator when specifying flywheels. The period of oscillation of the governor of the engine should not be lost sight of; this is generally fairly long, and may not impossibly give rise to resonant oscillations.

So far, we have considered the forced oscillations caused by the uneven turning moment of the prime mover in a generator working in parallel with a number of others. A very similar and equally important problem is that of a synchronous motor or rotary driven from mains in which the potential varies periodically owing to unevenness of rotation in the supply generators. Here, if the motor or rotary had no flywheel effect at all, it would follow the generators precisely in their oscillations. In the case of a rotary, it is unusual to have any flywheel, and consequently the oscillations of the rotary may exceed in amplitude those of the generator. Furthermore, the danger of actual resonance with the revolution of the engine is in this case very much greater. I came across a case recently of a motor-generator which could not be worked owing to resonance. Its natural period happened to be very nearly equal to that of the revolution of the generator—about two-thirds of a second—and it dropped out of step in a very short time, though the variation of turning moment in the period in question must have been quite small. By altering the field current so as to increase the natural period about 25 per cent., the forced oscillations disappeared almost completely, showing that the difficulty was entirely due to resonance. This suggests the reflection that it might possibly be better in some cases to put flywheels on the comparatively high speed rotaries, and allow a small flywheel and a bigger angular deviation in the slow-speed generators.

The question of free oscillations is a very much more complicated and difficult one than that of forced oscillations The period is, of course, easily determined, but the importance or otherwise of these oscillations depends almost entirely on the way in which they are damped. The oscillations may continually increase according to an exponential law, and the running of the machine will be impossible as a practical thing.

Consider an ideal synchronous motor in which the exciting current is maintained absolutely constant, while the field magnets and the armature core and conductors are so perfectly laminated that no appreciable eddy currents flow therein. I find that the motion of such a motor is unstable, provided that $\iota p > \rho$. Here ρ is the resistance and ιp is the reactance of the armature and any conductors in series with it. The condition $\iota p > \rho$ is generally fulfilled, so that an ideal motor such as that described is in general unstable, and all motors have this element of instability. In actual machines, however, there are a number of causes which give rise to real viscous forces, and generally overcome this tendency to instability. Such are the local currents induced in the substance of the armature conductors, and (generally, but not always) the "amortisseur" effect of currents induced by the oscillations in the pole-pieces, the field coils, and in any special "amortisseur" coils put there for the purpose.

Of the causes mentioned above as making for stability by producing a viscous damping effect, the most important is that described as giving rise to "amortisseur" action. Consider an ideal motor of the type described in the last paragraph, coupled to mains giving constant alternating potential, moving steadily and doing external work. For simplicity we may suppose the open-circuit potential of the motor to be equal to that of the mains. The effect of the armature current on the field will be to decrease the induction in the field magnets somewhat and also to distort it, so that the point of maximum induction and zero back E.M.F. is displaced backward against the direction of rotation. Suppose that the motor executes oscillations about the position of steady motion. Then the field will experience variations of like period both as regards its magnitude and its distortion.

Now, suppose that the pole-pieces are surrounded by short-circuited copper conductors, and that the pole-faces are covered with copper plates, or have copper conductors threaded through them to form a grid. Then the changes of magnetising force due to the armature current will cause induced currents to flow in these conductors, and the general effects of the currents will be to somewhat reduce the amplitude of the changes of induction in the pole-pieces, and to cause them to lag rather behind the changes in armature reaction which gave rise to them. In other words, the currents then circulating in the "amortisseur" coils are such as to reduce the magnetisation somewhat and to displace the point of maximum induction or zero open-circuit E.M.F. rather behind the position which it would occupy in ordinary steady motion.

We have to consider the effect of these changes in the induction on the torque at this moment. First, as regards the demagnetisation, due to diminution of current in the field coils or to currents in short-circuited windings surrounding the pole-pieces. It is easy to show that the effect of reducing the field current in a synchronous motor may be either to increase or diminish the torque—it depends on the load on the motor. Similar considerations apply when the dynamo is working as a generator, only in this case the effect of the induced currents may be to increase the magnetisation.

We may now consider shortly the damping effect of solid pole-pieces, copper plates over the pole-faces, or copper bars threaded through the pole-face to form a grid. As already pointed out, the effect of the currents in such conducting bodies at the moment when the motor is in the position of steady motion, but moving with more than the steady motion velocity, is to so distort the field as to move the position of maximum induction somewhat behind that which it occupies in steady motion. This is in effect the same as reducing the phase difference between motor and generators, and it therefore in all cases results in a reduction of the torque of the motor as compared with the normal steady motion torque, or on the balance in retardation of the motor. Hence damping coils of this kind invariably exert a true damping or viscous effect. Moreover, I have worked out the amount of the effect, and find that it is much greater than that due to the variation of current round the pole-pieces. It is these conductors across the face of the pole-pieces that are the really useful "amortisseurs," and by their use it would seem that the motion can always be made stable

I do not propose here to go into the actual value of the damping effect produced by these "amortisseur" coils. It has been worked out and the results will shortly be published. One thing, however, may be noted here, and that is, that as the resistance of the coils is diminished, the effect increases to a maximum and then diminishes. It is obvious that if the pole-pieces were surrounded by perfectly conducting coils and faced with perfectly conducting plates there could be no changes of induction produced by an oscillation about steady motion, and, therefore, no damping effect. The point is that the coils diminish the amplitude of the changes of induction produced by armature reaction approximately in proportion to their conductivity, and at the same time give rise to a difference of phase between those changes and their cause. The amount of damping effect is proportional to the amplitude of the changes and to the phase difference. It is therefore possible to increase the conductivity of the coils too far—that is, to such an extent that the diminished amplitude more than compensates the increased phase-difference. Whether this happens in practice I am not prepared to say, as it depends on many elements, such as the period of oscillation, amount of armature reaction, &c., but I am clear that it is not impossible with constants such as one meets with in ordinary designs.

One other point is of interest in connection with "amortisseur" coils. They have been regarded here as a means of removing that tendency to instability as regards free oscillations which is inherent in all machines. Of their great value for that purpose there can be no doubt whatever. It has often been suggested that they also play an important part in reducing the forced oscillations which were considered in the first section of this paper. My own belief, however, is that their action in that respect is insignificant.

To sum the whole matter up, the proper way to deal with forced oscillations is to use the right fly-wheel, while damping coils must be used for giving stable free oscillations.

ELECTRICAL INSTALLATIONS IN INDIA.

[By a Bombay Correspondent.]

During the past year the subject of the electrification of the larger Indian cities and districts has been the subject of considerable discussion. Calcutta has for some time possessed a system of electric tramways, the history of which has, however, been sadly marred by the repeated deaths of natives from fallen wires; electric fans have been generally introduced in the larger hotels and in many European bungalows. Madras also followed the example of Calcutta, and adopted an experimental system of both tramways and lighting. Both of these are now to be extended. Bombay, with its three-quarters of a million of inhabitants, possesses neither at the moment. The Corporation have, however, granted a concession for both to the Brush Electrical Engineering Co., and it is generally understood that operations will shortly be commenced. The problem of electric traction in this city is, however, complicated by the very good horse tram service which now prevails. This is in the hands of an American syndicate, who work it for all it is worth with characteristic trans-Atlantic energy. The conditions are also especially favourable for horse traction; there are no gradients, and most of the streets, especially in the native quarter, are narrow and densely crowded by a native population. Horses, fodder and labour are all exceptionally cheap, the consequences being that a horse tramline can be worked at a phenomenally low cost. This is shown by the low fare charged, viz., 1d. per journey of six or eight miles, in addition to which the "correspondence" system prevails. The Brush Co., who have undertaken the electrification of this line, and who will indirectly have to buy up the existing company at a profit to them, will have to produce one of the cheapest electric tramways in the world to get below the existing fares.

The progress of this enterprise will be full of more than local interest. The lighting of the streets which will be in the hands of the same company will also be a large undertaking. There is further a considerable demand for motive power, especially for punkahs, for printing and for many small industries which at present demand gas or oil engines. The coming electrification of Bombay should also offer an attractive market to the manufacturers of dynamos and electrical accessories generally. There should be an enormous demand for large supplies of electric energy from the various cotton mills, if the sale price can be adjusted at from 3d. to 4d. per B.T.U. Labour is cheap at 4d. per day, whilst the price of coal varies from 12s. per ton for Bengal, and 19s. for Welsh qualities. The Brush Co. have to tackle an installation of considerable magnitude. In the cities of Northern Bengal, the introduction of electricity is the dominant question. Delhi was to have initiated its municipal lighting before the Durbar, but the contractors only succeeded in digging the holes in the streets for the lighting standards before that historic event; the unfortunate delay left the narrow streets of that interesting city particularly dark during the late great ceremonials. Lucknow is keenly alive to the desirability of this new adaptation of energy for both lighting and traction purposes. Its Corporation have been approached for a concession by several syndicates, but the municipality is keenly alive to the opportunity presented for "making bargain" for the future as well as the present. A committee has been appointed to draw up a list of the Corporation's terms, for submission to all applicants. Messrs. Crompton & Co. are generally reported to have secured a concession from the Nizam for the monopoly of the supply of electricity to his Highness's dominions. Deccan concessions for all sorts of purposes are so generally known on this side of the Indian Ocean, that they are not locally regarded as being very desirable speculations. Karachi is also much talked of as a promising field for electrical speculation. The Corporation, however, are so satisfied with their existing lighting by Kitson and Washington kerosene lights, that something under 3d. per B.T.U. will be necessary to tempt that municipality to hand over its street to an electric monopoly. Still, the advent of electric installations is regarded as being both inevitable and immediate.

In March, 1903, the Indian Electricity Act, to make better provision for facilitating and regulating the supply and use of electrical energy for lighting and other purposes, received the assent of the Governor-General of India. This is practically divided into two parts. Part II clearly defines the conditions under which licenses for public supply will be granted, and with the supplementary regulations which came into force on September 15th, provides working instructions for the practical introduction of electricity. Under the provisions of this Act, "no person shall supply energy for electric traction or for any purpose to the public except under, and in accordance with, the terms and conditions of a license granted by the local Government." A condition precedent to the consideration of an application is the consent of every local authority concerned. Due advertisement must be given of the proposed application for such a license; after the expiration of three months from the date of such application, the local Government will consider the claims of the applicant in connection with any objections which may be raised thereto on the part of any interested person. Having obtained the necessary order, the licensee is thereafter bound by the following conditions. "The pressure of a supply delivered to any one customer, other than a tramway authority, shall not exceed 250 volts at any two terminals within reach of one another." "The pressure of a supply to a transforming station, or to a transforming apparatus on a consumer's station, may not exceed 3,000 volts whether the current be continuous or alternating." The specification in reference to electric supply lines is also very clear; amongst other things, it is provided that—

"The sectional area of the conductor in an electric supply line shall not be less than the area of a circle of $\frac{1}{10}$ in. in diameter, or in the case of an aerial line, than the area of a No. 8 B.W.G., and where the conductor is formed of a strand of wires, each separate wire shall be at least as large as No. 20 B.W.G.

"If the supply line is covered with a metallic sheath, such covering must make an earth connection."

All mains must be efficiently tested for insulation for one hour with 50 per cent. overcharge.

Provision is also made for the distance of supports from each other; in the case of the use of a copper wire, the section of which shall not exceed ·5 in., the supports are to be not more than 150 ft apart. All such lines must be more than 20 ft. above ground level, and must not approach any building nearer than 7 ft.

Provision has to be made to protect existing telegraph wires from any danger to be apprehended from falling wires. In the case of underground wires which may be insulated only in part, as in the case of the conduit tramway system, no voltage higher than 500 is to be employed.

Provision is also to be made against leakage, either in the mains or in consumers' internal fittings; in the latter case the supply must be discontinued until the defect is remedied. The supply circuits must be so arranged as to enable the current to be completely withdrawn from any number of houses (not exceeding 100) in case of a serious breakdown of the main.

For the purposes of traction the voltage is restricted to 500, except by the special sanction of the Local Government, who, in considering this point, will take into consideration climatic, local and other conditions. Elaborate precautions are insisted upon to secure an efficient earth return to the negative pole of the dynamo. The total resistance allowed for the earth return is not to exceed 2 amperes per mile of single tramway. The supply line is to be split into sections, no one of which shall exceed ½ mile in length, and shall be fitted with an emergency switch for use in case of necessity.

Part III. of the Act deals with private installations which, under this new law, pass under Government control. "No person shall for any purpose in any street, or in any place in which 100 or more persons are likely ordinarily to be assembled, or which is a factory, use energy without giving seven days' notice of his intention to the Commissioner of Police, or in complying with the rules specified." This clause clearly brings under Government control the various hotel and mill, as also the private installations of the various native princes (of which there are many).

The power of inspection and testing by officers appointed by the Local Government is to be enforced. The cost of this will be borne by the owner; a rate of fees for such inspection is arranged. It is based upon a charge of R 1 for every kilowatt of the plant's capacity, with a minimum charge of Rs.16 and a maximum one of Rs.200.

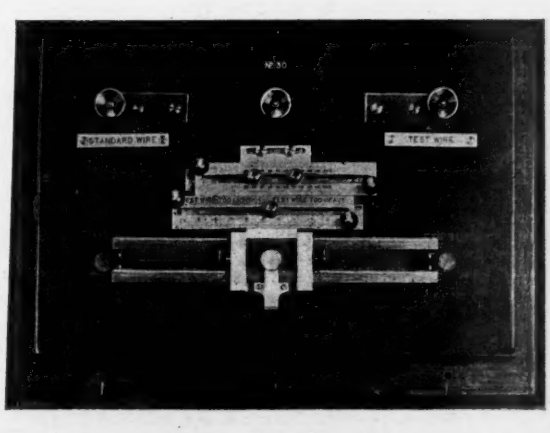
The pressure of the supply generated by any owner shall not exceed 500 volts if continuous or 250 volts if alternating. The same general conditions as to erection of aerial or underground lines as are specified for a public installation, also apply. The owner is to be responsible that his fittings are in all respects fit for the use of energy, and shall take all due precautions against fire. Under special circumstances the Local Government may grant the use of a "high pressure" system, by which is meant an installation up to 3,000 volts, either continuous or alternating; but for this special official sanction is necessary.

This Act has thus clearly defined the future of electricity in India, and has removed much misconception and uncertainty which formerly existed. Whilst most carefully protecting the public interests, it affords every opportunity for steady and safe development. Unfortunately, municipal life in India is far behind that which prevails at home. For the greater part, its members are not of the class from whom one can reasonably expect much in the direction of wise and successful municipal trading. The future of electricity in India must depend upon private enterprise. Now that the law is codified, there is a large promising and legitimate sphere for electrical supply companies in most of the larger Indian towns.

THE CONDUCTOMETER.

A Direct Reading Conductivity Meter.

One of the most frequent and important measurements required in the manufacture of cables for electrical purposes is, unfortunately, one of the most arduous and difficult to carry out with accuracy. This is the determination of the conductivity of the copper wire of which the strands are composed, a quality which no two hanks of wire possess in the same degree. The possible loss which may be incurred by failure to comply with the terms of the specification to which a cable is made, is too great to permit of risks being



The Conductometer

taken, in view of the narrow margin which is allowed under modern conditions; this is especially true in the manufacture of submarine cables, the properties of which are so minutely specified and tested. An instrument which has been devised by Mr. Rollo Appleyard for the reduction of this troublesome operation to a mere matter of workshop routine, capable of performance by practically unskilled operators, will, therefore, be warmly welcomed by the industry.

The fact that the so-called "Matthiessen's standard" is indefinite to the amount of ± 0·56 per cent.—a range of more than 1 per cent.—was, we believe, first clearly demonstrated by Mr. Appleyard himself, in the ELECTRICAL REVIEW of June 19th, 1903; but apart from this ambiguity, which can be avoided by a convention, considerable variations occur in the diameter of a wire as it comes from the dies. This being the case, great refinements of accuracy in the measurement of conductivity are obviously superfluous, and, struck with this fact, Mr. Appleyard set about devising some means whereby it could be turned to good account, with the result described below.

The problem was, briefly, to quickly compare with a standard wire a succession of samples of approximately, but not exactly, the same conductivity and diameter as the

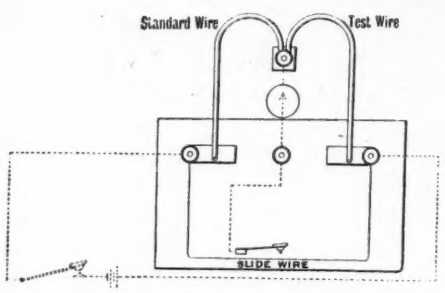


FIG. 1.

standard, with the minimum of expenditure of time and labour, and to read the result as percentage conductivity from a divided scale, while readily compensating for the variation of the mean diameter of the test wire from the normal and neutralising the effect of atmospheric temperature. Further, the standard wire itself might not be of 100 per cent. conductivity, and the difference must be compensated for. The standard of accuracy aimed at was a maximum error of ± 0·1 per cent.—very far within the limits of practical requirements.

The means whereby the desired end has been attained are of the simplest description; the instrument is essentially a slide-wire bridge, of which two arms are formed by the standard wire and test wire, as shown in fig. 1. As the position of balance can never be far from the centre of the slide-wire, only a short length—about 10 cm.—of the wire is exposed, the remainder being suitably disposed within the case of the instrument. Provision is made for attaching the standard and test wires, or heavy copper rods leading thereto if the instrument is not fixed (as is preferred) close to the testing bench, and the connections to battery and galvanometer. The only, but essential, novel feature is, therefore, the system of scales shown in the middle of the apparatus, the use of which is explained below.

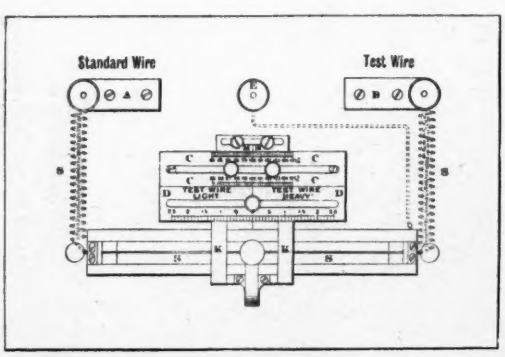


FIG. 2.

The solution of the problem affords an interesting example of the successful application of scientific methods plus brains to the attainment of an essentially practical object by means which could not have been devised by experiment. The investigation necessitated only the most simple mathematical treatment; but it will suffice here to indicate the successive steps involved, while a detailed account of the work will be found in the *Proceedings* of the Institution of Civil Engineers, Vol. CLIV., Part IV.

In the first place, Mr. Appleyard found that, between the limits of 96 and 104 per cent. conductivity, with a standard wire of 100 per cent. conductivity, and of the same diameter as the sample, a scale graduated in equal divisions could be applied to the slide wire, upon which the percentage conductivity of the wire tested could be directly read off. It was desirable, however, frequently to use as a standard a wire which might not itself be of 100 per cent. conductivity. It is obviously necessary to determine the conductivity of such a standard by independent means; this done, it is only necessary to set the aforesaid scale with regard to the slide wire, so that the scale reading for the conductivity of the standard wire coincides with the electrical middle of the slide wire. Clearly, if balance is obtained at this point, the test wire is of the same conductivity as the standard, the value of which is shown on the scale; while variations from this value are read off according to the position of balance exactly as before. The scale in question is marked C C in fig. 2, and is similarly graduated on both edges for convenience; the upper graduations are used for setting the conductivity reading of the standard wire against the middle point M M of the slide wire, which is determined once for all when the bridge is adjusted. The lower graduations form the actual working scale for the conductivity of the sample.

The compensation for inequality of diameter was a difficult matter, but of great importance, owing to the frequency of slight variations in the diameter of wires, and

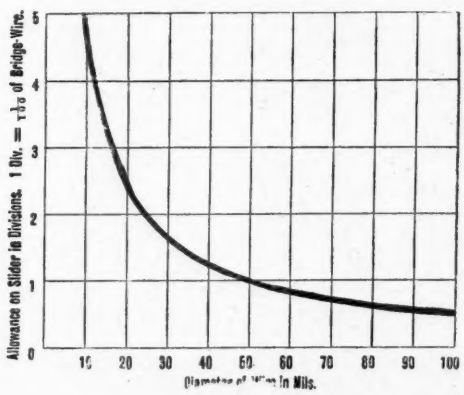


FIG. 3.

their great effect upon the resistance of such. Moreover, the effect varies widely with the actual diameter of the wire. To surmount this difficulty, a table of corrections was made out and embodied in the form of a curve (fig. 3). This, it will be seen, gives the correction required for any size of wire between 10 and 100 mils, in terms of divisions of the slide-wire per mil of difference. In actual practice the variations do not exceed 1 mil, and it is convenient to make a table of the corrections for each tenth from 0 to 1 mil for the gauge of wire under test. To apply the corrections, a "diameter-scale" is affixed to the slider in such a way that it can be moved sideways with regard to the zero of the latter, and clamped in place; the gauge mark on this scale is thus displaced to the right or left, to a distance corresponding with the reading on the scale, and against this mark the conductivity of the wire tested is read when balance is obtained.

The standard may either be a specially prepared coil, adjusted to have the resistance corresponding to the normal length (say, 30 ft.) and diameter of the samples at 100 per cent. conductivity and the same temperature, and made of the same material; or it may be one of the sample lengths, the conductivity of which has been determined by the ordinary methods. In the latter case it is stretched alongside the sample, so as to be at the same temperature, and the correction for the conductivity of the standard is made on the conductivity scale, unless the standard happens to be of 100 per cent. conductivity. The diameter of the sample is quickly measured at several points with a micrometer, and from the average result the necessary correction is made on the diameter scale. Balance is then obtained with the slide-

wire bridge, the conductivity of the sample read off, and the sample replaced by another one. For this only the diameter correction is necessary before balancing, and so with all other samples of the same gauge. There is no need to cut off the samples from the hanks, as a length can be run off and clamped, tested and wound up again without injury. A temperature correction is unnecessary, as the standard is always of the same material and in the same surroundings as the sample tested.

It will be clear from the foregoing that, as we have personally witnessed, after the standard has been fixed and the correction applied, the complete operation of testing a sample occupies only a minute or two; moreover, it can be, and is, carried out by quite unskilled operators—even girls fresh from school. It remains to consider the degree of accuracy attained. The precision aimed at, as we have stated, was a maximum error of 0·1 per cent. One of the instruments was tested at the National Physical Laboratory throughout its range, with remarkable results. With a standard of 100 per cent. conductivity, and samples ranging from 95 to 105 per cent., the error was 0·1 per cent. at the extreme ends of the range, but from 98 per cent. to 103 per cent. the error was negligible, being, in fact, 0 from 100 to 103 per cent. Even with standards of 95 and 105 per cent., and diameter corrections of 2·5—extreme conditions, never likely to occur in practice—the error in no case was so great as 0·2 per cent., rarely exceeding 0·1. The average error of the whole of the tests of various kinds, 47 in number, was 0·065 per cent., and within the ordinary limits of practice—98 to 102 per cent. conductivity of the standard, and up to nearly two divisions diameter correction—the error never exceeded 0·1 per cent. for samples of 95 to 104 per cent. conductivity. As a crucial test, two pieces of copper wire, of slightly different diameters but equal lengths, were tested by an accurate method which gave the ratio of their conductivities as 100·05 per cent.; the same ratio, as measured by the conductometer, was 100·02 per cent.—a remarkable result indeed. The instrument is neat and compact, besides being accurate, and should be of great utility to cable manufacturers.

THE EVIDENCE ON MUNICIPAL TRADING.

(*Concluded from page* 522.)

The more one examines the evidence presented to the Joint Committee, the stronger the case appears in support of the conclusions arrived at by them in their report. In this busy world, it cannot be expected that ratepayers generally will find time (even if their generally apathetic nature should stimulate their interest sufficiently) to read through the 462 pages comprising the Blue-book.

The Committee devoted only nine days to taking evidence, examining 31 representative witnesses, who dealt with the question of municipal trading accounts exhaustively, and incidentally expressed opinions *pro* and *con* upon the general principles involved in municipal trading.

The public are able, therefore, to contrast the views of anti-municipal traders like Sir Andrew Noble, with those of Mr. Edward Robertshaw Hartley, a town councillor of Bradford, who said to the Committee, "I had better say right out that I am a Socialist." The former thinks that anything that can be equally well done by private traders should be left to them; in the first place, because people who are in a private trade will not undertake it unless they know something about it; whereas, corporations consist principally of a number of small shopkeepers, and it is not possible, except in exceptional instances, that they can understand the new business that they undertake to manage, having little interest against expenditure, or, rather, possibly an interest in expenditure, and will not be careful of the money of the ratepayers. Sir Andrew speaks feelingly as a contributor to the rates of Newcastle and Manchester by no less than £18,000 per annum.

Compare these views with those of the Bradford socialist, who is a fair type of the municipal traders, who, with light hearts and purses, have plunged their towns into enormous debts and responsibilities, the rapidly increasing rates affecting them personally to an inconsiderable extent, but, being most onerous to the great industries upon which the prosperity of the localities depends. Mr. Councillor Hartley declares himself to be an ardent advocate of municipal enterprise, favours the working of coal mines, the establishment of bakeries, supply of flour, and says he does not see where the legitimate ending is to come. He is, in fact, an outspoken disciple of John Burns, and would carry on any trade regardless of risks.

As to taking risks, he says, "Why should not the people take the risk themselves? Why should we ask anybody to take the responsibility for us?" And, with reference to house building, he says that corporations ought to build houses so that tenants, having two houses available for every one required, would get them at cheap rent!

This is a no-monopoly cry with a vengeance; provide double of everything required, and then the people who are to take all the risks will be sure of cheap rents.

When Mr. Hartley began public life, his motto was, "All public service for the public good," a principle to which all can subscribe, but he applies it to universal trading, as he considers that the only limit is, "as soon as ever we come to anything the public do not require."

Of course, increased wages is an essential item in the socialist programme, and Mr. Hartley triumphantly points to the fact that, since the Corporation of Bradford took over the tramways, men who worked 80 hours for £1 a week now work less than 60 hours for 25s. a week without loss to the public.

The chairman of the Committee mildly suggested that the public should not pay unreasonably high wages to the tramway employés as against other workmen, but Mr. Hartley did not believe such a contingency would ever arise, and in any case justified the men in using their votes to get up their wages.

Mr. Hartley is so satisfied with the working of the trams, that he told the Committee he was convinced that, as they can run trams in Bradford, the working man could be also helped by running a wool-combing establishment, and argues that as the chairman of the Tramways Committee made an immense fortune as a wool-comber, in the near future the town should begin a wool-combing establishment, and make him chairman, as he is an expert!

The question as to whether the trading pays or not—apart altogether from the policy of interfering with private enterprise—naturally gives rise to the necessity for properly kept and audited accounts. Upon this essential point there was considerable evidence, the battle raging around the character and ultimate results of sinking funds, depreciation, obsolescence, valuation of assets, investments of sinking funds in other municipal undertakings of the same local authority, overdrafts, and other advances by bankers, unauthorised borrowings, and, above all, the necessity for proper independent audits, with as much uniformity in keeping the accounts as local circumstances will admit of. Upon all these matters the evidence was of considerable interest.

One of the most practical recommendations came from Mr. Henry Sherley-Price, partner in the well-known firm of Wheatley Kirk, Price & Co., who claim to be the largest engineering valuers in Europe. He considers it to be absolutely essential to the accuracy of trading accounts that depreciation of plant should be written off, and he urges the importance of this by the remark:—"Take the plant of an electrical lighting station erected, say, 10 years ago, and costing, say, £50,000 to erect, he would be a bold man who would say that the actual value of such a concern to-day is anything like half that amount. If no provision has been made to meet this depreciation, the profit and loss account will be wrong to that extent."

Mr. Sherley-Price confirms our repeated contention that this provision is quite apart from sinking fund, which is only a provision for repaying loans. He says that there is scarcely an important electric light or power station in the United Kingdom above five years old which has not had to discard costly plant, some of it scarcely used, in order to replace it with some new invention giving more economical and reliable results; and the witness handed to the Committee a list of such discarded plant, mainly belonging to municipal undertakings which his firm had for disposal.

Mr. Sherley-Price considers that the assets should be valued periodically, and gave his personal experience of the course adopted in this respect by leading private firms, having personally valued over 40 millions sterling of manufacturing plant and property, principally engineering. He stated that even an expert valuer cannot fix a rate for depreciation which will hold good for any lengthened period without periodical personal inspection. He gave an example of the importance of the question by quoting the sale by the Leeds Corporation of tram engines and steam-drawn tramcars for £40 each, which cost £800 or £900. He is of opinion that corporations who do not keep proper depreciation accounts, rather than face the throwing out of large items when they have to show them as losses, continue with these old items.

With such evidence before them, the Committee were fully justified in their recommendation that "auditors should be required to express an opinion upon the necessity for reserve funds, of amounts set aside to meet depreciation and obsolescence of plant, in addition to the statutory sinking funds, and of the adequacy of such amounts."

Gateshead-on-Tyne Tramways.—The new section of tramways leading from the former terminus at Sheriff Hill to Wreckenton, was inspected by Colonel Von Donop on the 1st inst., and the line has since been opened. Wreckenton is a fairly large village situate on the Fells, and although in close proximity to Gateshead had no means of intercommunication other than the old-fashioned brake, or bus. It is a considerable distance from the railway, and the residents have been for a long time desirous of possessing a tram service, which has now been afforded them by the Gateshead Tramways Co. The permanent way contract has been carried out by Mr. J. J. Robson, the overhead work being done by the company under the superintendence of Mr. P. Shannon. It is stated that the cost will approximate upon £10,000. There is one heavy gradient on the run, which is about 1 in 10, but this was taken perfectly satisfactorily and the trial was entirely successful.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

20,245. "Improvements in or relating to electric rheostats, motor starters, regulators and analogous electrical apparatus." R. F. Hall. September 21st.

20,274. "Improvements in and relating to electrical casing or conduits." Sir Hiram Maxim Electrical and Engineering Co., Ltd., A. W. Hill and J. Harrington. September 21st.

20,285. "An improved machine for the separation of ores and other materials by means of electro-magnets." W. Blackmore. September 21st.

20,291. "Improvements in electric fittings such as switches or the like having combined insulating and conducting portions." C. F. Ritchel. (Date applied for under Patents Act, 1901, October 13th, 1902, being date of application in United States.) September 21st. (Complete.)

20,301. "Improvements in commutator brushes." The Morgan Crucible Co., Ltd., and C. W. Speirs. September 21st.

20,302. "Improvements in commutator brushes." The Morgan Crucible Co., Ltd., and C. W. Speirs. September 21st.

2,303. "Improvements in commutator brushes." The Morgan Crucible Co., Ltd. C. W. Speirs. September 21st.

20,308. "Improvements in switches for railways, tramways and the like." E. B. Entwistle. September 21st. (Complete.)

20,313. "Process for the production of a porous, hard electrode mass, insoluble in alkalies, from metallic oxides or metallic powders." G. A. Wedekind and H. P. R. L. Porscke. September 21st. (Complete.)

20,366. "Improvements in coverings for insulating electrical wires and the like." L. Frank. September 22nd.

20,401. "Improvements in electric switches." C. E. Hunter and W. H. Warren. September 22nd. (Complete.)

20,405. "Improvements in the method of producing rapid electrical oscillations and systems of devices therefor." F. Schrottke and Gesellschaft fur Drahtlose Telegraphie m.b.H. September 22nd. (Complete.)

20,423. "Improvements in the ventilation of dynamo-electric machines." H. M. Hobart. September 22nd.

20,424. "Improvements relating to sparkless running of commutating dynamo-electric machines." F. Punga. September 22nd.

20,435. "Improvements in or relating to electric ignition apparatus for internal combustion motors and the like." J. Budge and C. E. Forman. September 23rd.

20,443. "Improved electrical lamp." E. Hermann. September 23rd.

20,450. "Improvements in electric arc lamps." F. W. E. Schuer. September 23rd.

20,497. "Electric plant for the synthetical production of nitric products by means of discharges of electricity in gaseous mixtures." J. Von Kowalski and I. Moscicki. September 23rd. (Complete.)

20,517. "Improvements in and connected with the fixing of pulleys, electric wires, and such like to ceilings." C. McCallum and J. McGruther. September 24th.

20,528. "Improvements in electric switches." A. Eckstein and A. J. D. Krause. September 24th.

20,547. "Improved arm-supporter for telephones and the like." H. Ehret II. September 24th. (Complete.)

20,569. "Improvements in or relating to pocket electric lighting devices." L. G. Sloan. (The Electrizitäts-Actiengesellschaft Hydrawerk, Germany.) September 24th.

20,572. "An improved electric induction device for medical and like purposes." V. Reichenberger and E. Weiersmuller. September 24th. (Complete.)

20,577. "Improvements in or relating to magneto-electric machines or motors." H. H. Knutzen. September 24th.

20,606. "Improvements in multipolar dynamo-electric machines." J. H. Holmes. September 25th.

20,611. "Improvements in dynamo-electric generators." M. Walker, September 25th.

20,633. "Improvements in attaching electrical insulators to insulator brackets." E. J. Chambers. September 25th.

20,634. "Improvements in attaching insulators to the tubular arms of telegraph and like poles." E. J. Chambers. September 25th.

20,641. "Improvements in telephone selective systems and apparatus therefor." N. S. McKinsey and A. R. Nelson. September 25th.

20,645. "Improvements in arc lamps." W. T. Upton, J. E. Elliott, and H. B. Pratt. September 25th.

20,658. "Improvements in or connected with overhead trolley lines for electric traction." A. G. Ionides and A. C. Manuel. September 25th.

20,662. "Improved means for guiding the trolley wheels of tramway vehicles at the junctions in overhead conductors." A. H. Holmes and H. W. Holmes. September 25th.

20,685. "Improvements in electrical resistance furnaces." W. Simm and T. J. Denny. September 26th.

20,691. "Improvements in or relating to the cells of primary batteries." A. J. George. September 26th.

20,700. "Improvements in trolley electric tramways." G. Hall. September 26th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1902.

351. "Improvements in connection with electrical bells, telephones, ringing keys, contacts, switches, indicators, relays, and the like." L. H. Parsons. Dated January 6th.

360. "Improvements in contact devices for electrical railways." E. P. Wetmore. Dated January 6th.

361. "Improvements in contact boxes for electric railways." W. M. Brown. Dated January 6th.

380. "Improvements in contact shoes for electric railways." W. M. Brown. Dated January 6th.

914. "An improved electric arc lamp for light-cure purposes." R. Otto. Dated January 13th.

918. "Improvements in or relating to electrical measuring instruments." R. S. Whipple. Dated January 13th.

993. "Improvements in or relating to telegraph and telephone wires." J. Wormersley and G. W. Wormersley. Dated January 14th.

1,021. "Improvements in electric switches." W. H. Chipperfield and E. S. Cooke. Dated January 14th.

1,027. "Improvements in sectional conductor systems of electric railways." E. W. Farnham. Dated January 14th.

1,028. "Improvements in sectional conductor systems of electric railways." E. W. Farnham. Dated January 14th.

1,061. "Improvements in or relating to telegraphic apparatus." F. G. Creed and W. A. Coulson. Dated January 14th.

1,104. "Improvements in or relating to dynamo-electric machinery." A. B. Soar. Dated January 15th.

1,126. "Improvements in methods of generating electrical energy." A. Wassilieff. Dated January 15th.

1,136. "Improvements in electrodes for arc lamps." A. G. Gebr. Siemens and Co., and H. Viertel. Dated January 15th.

1,220. "Improvements in motor cycles and other motor vehicles." W. J. Lloyd and W. Priest. Dated January 16th.

1,223. "Improvements in the driving mechanism of motor-cars." A. Schmid. Dated January 16th.

1,229. "Improvements in telegraphs." W. D. Kilroy. Dated January 16th.

1,238. "Improved collector rings for electrical machines." British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric and Manufacturing Co., Pittsburg, U.S.A.) Dated January 16th.

1,251. "Improvements in and relating to electricity meters." W. M. Mordey and G. C. Fricker. Dated January 16th.

1,313. "Improvements in and relating to surface contact systems for electric traction." A. Rast. Dated January 17th.

1,323. "Improved apparatus for cleansing tram rails and the like." C. H. Gerrard. Dated January 17th.

1,343. "Improvements in electric fuses." Callender's Cable and Construction Co., and H. Hastings. Dated January 17th.

1,344. "An electric switch." G. Higginson. Dated January 17th.

1,355. "Improvements in the construction of underground conduits, more especially intended for use of underground electric traction." T. E. Devonshire. Dated January 17th.

2,035. "Improvements in electric arc lamps." H. Baggett. Dated January 25th.

3,116. "Improvements in safety fuses for electric circuits." A. D. Smith. Dated February 7th.

3,142. "Improvements in or relating to safety-devices for electric overhead conductors." A. J. Boult. (L. Negro, Genoa.) Dated February 7th.

3,153. "An electro-magnetically operated switch for opening and closing an electric circuit." C. E. G. Gilbert. Dated February 7th.

3,154. "Improvements in sockets for uniting two telegraph wires." S. Frank. Dated February 7th.

3,163. "Improvements relating to the secondary circuits of alternating currents." R. Grisson. Dated February 7th.

5,952. "Improvements in and relating to electric arc lamps." W. P. Thompson. (E. Sander.) Dated March 11th.

5,978. "Improvements relating to rectifiers for single or polyphase alternating currents." A. Nodon. Dated March 11th.

6,558. "Improvements in telegraph poles or the like." A. Bourgeat. Dated March 18th.

6,653. "Improvements relating to electric switches for controlling electric motors or other electric circuits." E. N. Bray. Dated March 18th.

6,817. "Improvements in telephone sets." J. E. Kingsbury. Dated March 20th.

7,125. "Improved electrical ozonising and circuit breaking apparatus." P. K. Stern. Dated March 24th.

7,195. "Improvements in or relating to arc lamps, more especially of the type known as 'Projector' arc lamps." C. Oliver. Dated March 24th.

7,260. "Improvements in and relating to electric incandescent lamps and to means for connecting the same in electric circuits." H. J. Leviles-Johnson. Dated March 25th.

8,181. "Improvements in and relating to devices for controlling polyphase and alternating current motors." W. Spielter. Dated April 8th.

8,456. "Improvements in or relating to electric ignition devices for gas or oil motors." F. Bryan. Dated April 11th.

10,102. "Improvements in or relating to apparatus for use in electro-plating." F. T. Jackson. Dated May 2nd.

10,302. "A portable apparatus capable of being concealed by a doormat or other covering, which completes a circuit of electricity when trodden on or otherwise pressed." J. Landon. Dated May 5th.

10,528. "Improvements in or relating to galvanic batteries for shot firing in mines or other works." C. Cook. Dated May 7th.

12,207. "Electro-thermic ventilator." F. De Mare. Dated May 28th.

12,695. "Improvements in or relating to steering devices for motor road vehicles." F. Porsche. Dated June 3rd.

13,759. "Improvements in electric current-taking devices." C. Portillo. Dated June 7th.

13,851. "Improvements in electric switches worked by electro-magnets or solenoids." Siemens Bros. & Co., Ltd., L. M. G. Ferreira and R. Wilkie. Dated June 18th.

14,202. "Improvements in self-regulating dynamos specially applicable to electric lighting of trains." H. Leitner and R. N. Lucas. Dated June 23rd.

14,774. "Electrical apparatus for working reciprocating tools." Vickers, Sons & Maxim, Ltd., A. D. Williamson and C. L. Sumpter. Dated July 2nd.

15,312. "Improvements in accumulators or secondary batteries." L. A. Genard. Dated July 9th.

15,715. "Improvements in or connected with electric cable-junction terminal and like boxes." C. D. Burnet. Dated July 15th.

15,963. "Improvements in or relating to the manufacture of bed-plates for secondary electric batteries." C. Vellino. Dated July 17th.

16,485. "Improved carbon brush-holder for dynamos." E. Gaud. Dated July 24th.

16,902. "Improvements in telephone systems and in apparatus for use in connection therewith." C. D. Watkins. Dated July 30th.

17,135. "Improvements in electric incandescent lamp-holders and switches." L. H. Newton and R. R. F. Neville. Dated August 2nd.

17,136. "Improvements in incandescent electric lamps." L. H. Newton and R. R. F. Neville. Dated August 2nd.

17,142. "Improvements in automatic switches for electrical circuits." A. S. Adler Dated August 2nd.

17,143. "Improvements in electrical systems for lighting and power." A. S. Adler. Dated August 2nd.

17,267. "Improved electrostatic high pressure voltmeter." Baron Kelvin. Dated August 6th.

17,386. "Improvements relating to electric condensers." H. H. Lake. (General Electric Co.) Dated August 7th.

17,387. "An improved combined carbon-cutter and screw-driver for electric arc lamps." H. H. Lake. (General Electric Co.) Dated August 7th.

18,816. "Improvements in commutators for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (H. F. T. Erben.) Dated August 27th.

18,870. "Improvements in dynamo-electric generators." M. Walker. Dated August 23rd.

18,923. "Improvements in direct-current electricity meters." H. H. Lake. (General Electric Co.) Dated August 28th.

19,431. "Improvements in lifeguards for electric cars and other vehicles." J. F. Mason and H. Kremnitz. Dated September 4th.

19,483. "Apparatus for teaching wireless telegraphy." L. Ancel. Dated September 5th.

19,572. "Improvements in trolley wheels for electric traction." H. H. Lake. (General Electric Co.) Dated September 6th.